WALKER, DIANE GALE. The Effects of Competitive Swimming on Selected Physiological Measures and Performance Levels of Seven to Ten Year Old Girls. (1970) Directed by: Dr. Rosemary McGee pp. 116

The purpose of this study was to determine the effects of competitive swimming on selected physiological measures and performance levels of seven to ten-year-old girls. Seven swimmers from the Green Valley Swim Team of Greensboro, North Carolina volunteered as subjects. The four selected measures, blood pressure, pulse rate, respiration rate, and grip strength, were taken before and after swimming at four levels of competition: at practice sessions, at league meet races, at time trials for the Community Swim Association City Meet, and at the City Meet. However, not all the subjects were measured in all four situations.

Within the limited amount of data collected, the following points seem justified: (1) For most subjects, physiological measurements taken after practice, after a league race, after a time trial race for the city meet, and after the city meet increased over measurements taken before each situation. This was true of systolic blood pressure, pulse rate, and respiration rate. The only function that seemed to deviate was the diastolic blood pressure. (2) The performance level measurement, grip strength, decreased after practice, league racing, time trial racing at the city meet, and at city meet racing. (3) When comparing measurements taken before each of the four competitive situations, the measurements started each time at a point a little higher at each level of competition. Therefore, it resulted that the physiological and

performance level measurements were highest before the city meet. This was true of systolic blood pressure, pulse rate, respiration rate, and grip strength. Diastolic blood pressure remained about the same before each different competitive situation. (4) When comparing measurements taken after each of the four competitive situations, the measurement at each level was a little higher than the previous level in the majority of subjects. Therefore, a steady increase was observed from practice to city meet races. This was true of all four functions. It appeared the physiological and performance level functions increased as the competitive level increased. Also, there appeared to be no apparent ill-effects to any of the physiological systems in any of the subjects as a result of participating in competitive swimming.

THE EFFECTS OF COMPETITIVE SWIMMING ON SELECTED PHYSIOLOGICAL MEASURES AND PERFORMANCE LEVELS OF SEVEN TO TEN YEAR OLD GIRLS

by

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CHAPTER I

INTRODUCTION

Competition seems to be almost a natural inclination of children. They are always playing and competing with each other as evidenced by games and sports such as "King of the Mountain," tug-of-war, jacks, and sandlot baseball. Children of pre-adolescent age enjoy competition and will find some way to compete whether it is with a friend, with a crowd, or against their own previous performance. (43) In April, 1957, during a speech before the American Academy of Pediatrics entitled "Fitness of American Youth," Dr. Barba remarked, "It is undeniably true that competition is here to stay and that it is a necessary part of life." (40:230)

In recent years the popularity of competitive sports has flourished. Interest has gone beyond high schools and colleges to organized sports for preadolescent boys and girls in elementary grades. This is true not only in the schools but also in the community. This encouragement of competitive sports for younger children is coming about both through local initiative and national sponsorship. (43) Numerous civic-minded citizens who like working with younger boys have created a strong recreation movement carried on outside the auspices of school personnel. (47) The adults have organized Little League baseball, pee-wee football, iddy biddy basketball, midget league ice hockey, boxing,

Lassie Leagues (softball for girls), and now competitive swimming teams.

> Whether there is a real need for this kind of activity or not, these groups are growing in strength and influence in practically all of the larger communities throughout the land. (47:224)

Since this upsurge of organized teams and competition, opinions have been voiced debating the value and wisdom of competitive sports for elementary aged children. Everyone seems to speak with authority and yet no one has produced enough conclusive evidence to say whether or not highly organized competition is harmful to preadolescent children. A fair amount of material has been printed on the subject. However, most of this is not based on scientifically oriented research. Research in the area of competition covers high school, college, and professional athletes mainly. Therefore, the focus on this paper was to explore competition on a lower age level. Swimming was the specific sports medium chosen.

In order to gain a closer perspective of competitive swimming for elementary children, two approaches were used. One was to read materials and studies in the area of physiology, competitive swimming, and related fields; and, the second was to acquire some firsthand experience by taking certain measures on members of a community swimming team during competitive situations.

Some data were collected on three physiological measures and one performance measure in order to have some tangible

evidence upon which to draw some conclusions. Also, information was gathered from swimmers concerning their experience in competitive swimming.

There has not been enough research done on the effects of competition on elementary school age children and, in particular, not in the realm of swimming competition. This thesis dealt only with physiological measurements. Psychological and sociological as well as physiological aspects must be considered also. However, several, including McCarthy and Reichert, might go so far as to say that, in their opinion and in light of knowledge to date, they believe competition would not be harmful under the following conditions:

1. use proper leadership and trained personnel,
2. use proper facilities and equipment,
3. equalize teams according to physical maturity of members as well as age,
4. have proper medical examinations and treatment,
5. play only local teams and tournaments without fancy uniforms, awards, and publicity.
6. keep the parents away. (35, 39)

CHAPTER II

STATEMENT OF PROBLEM

The purpose of this study was to determine the effects of competitive swimming on selected physiological measures and performance levels of seven to ten-year-old girls. Seven swimmers from the Green Valley Swim Team of Greensboro, North Carolina served as subjects. The four selected measures, blood pressure, pulse rate, respiration, and grip strength, were taken before and after swimming in practice sessions and in competitive meets.

Definitions

Community swimming pool team. A team representing one of the fifteen community pools. In this case it was Green Valley Pool.

Practice session. A typical daily swimming practice at the home pool in preparation for a meet.

Competition. Swimming where two or more swimmers race against each other and time in a specific event.

Meet. Two community pool teams within the same league competing against each other in six events for five age groups.

City-Wide Meet. Members of fifteen community pool teams competing together for two days to win the city title.

Children. Young people below the age of high school students and especially those in elementary school. In this

study, children specifically refers to girls seven through ten years of age.

Elementary school age. Children in grades one to six or from about six to eleven or twelve years old.

Preadolescent. The period before puberty, approximately nine to twelve years of age.

Limitations

1. Controls: The study took the form of field research so there was no way of executing controls on most factors.
   a. There was no control over what might have happened to the subject before she arrived at a practice or meet.
   b. There was no way to control eating and sleeping habits.
   c. There was no way to control the amount of other exercise or activity.
   d. There was no way to control air or water temperature.
2. Measurements: Due to the fact that testing was done in a field type situation rather than in a controlled laboratory atmosphere, some procedures were perhaps slightly irregular. The study lacked refined measurement methods.

a. The young age of some subjects made measuring somewhat difficult.

b. Outside noises of crowds and other things sometimes made it difficult to hear when taking measures.

c. Measurements were not taken every day on every subject.

d. Measurements could not be taken immediately before the start of a race.

e. The importance of accurate measurements was not stressed to the subjects.

f. Measurements were not confined to one specific event.

3. Subjects: Selection of subjects was limited to volunteers from one particular community swimming team.

a. The subjects may have been affected by being singled out for measurements.

b. There was no way to be sure the subjects did their best on the grip strength test.

CHAPTER III

REVIEW OF LITERATURE

The review of literature is a consolidation of research studies and articles to show what has been discovered concerning competitive swimming and physiological measures of elementary school aged children. The five areas reviewed were child growth and development, physiology of children, emotional stress, organized competition for elementary school children, and swimming for elementary school children. Each section in the review summarizes one of these topics.

Briefly, section one presents a basic picture of the child by giving general growth and development patterns of children in middle childhood (ages six to nine years) and preadolescence (ages nine to twelve years). The second section summarizes the physiology of children as it relates to their blood pressure, pulse rate, respiration, and grip strength. Section three deals briefly with emotional stress as it pertains to stress in conditions of competition. The fourth section reviews material written on organized competition for elementary children. Some of the information came from research studies. More material came from the numerous articles giving personal opinion based on experience. Very little research has been conducted on the child seven to twelve years of age and particularly not on competitive swimming within that age group.

Growth and Development

In order to get a general picture of the child seven to ten years of age, some basic physical, mental, social, and emotional characteristics are listed. These are divided into two age phases: the first is middle childhood, roughly six to nine years and, second, preadolescence, nine to twelve years of age.

Middle childhood. Middle childhood is characterized physically by changes of proportions in bodily and facial features. (1) Muscular coordination is still uneven and incomplete, but there is more control of the larger muscle groups. (14) The muscles need exercise (8) and the children enjoy play activity that makes use of the whole body. (14) It is at this time that children begin to learn physical skills necessary for ordinary games. (6) The amount of activity of the child during this period changes. Sometimes he is very active and at other times inactive. (5) He works and plays hard. He may have periods of such complete concentration in doing something that he may not hear people speak to him. (50)

The mental characteristics of the middle childhood period show no distinctive changes occurring in intellectual growth except that of progress which is uneven and unpredictable. (1) The child is learning to read, write, calculate and is generally acquiring other knowledges and skills. (14) Even though the child's curiosity is active, his perseverance is low and attention weak. (8)

The greatest changes that take place in middle childhood occur in the social and emotional realms. This is the time when the child starts to school and is thrown into large groups of people. He has to learn to adjust to these new social situations such as learning to work and play with others his own age. During this period, the child is learning to be more independent, to take responsibility, and to control emotions. (14) Differentiation of sex roles is beginning to be realized now. Also important is the establishment of a wholesome self-concept and development of a conscience. (1)

Preadolescence. The second stage important to this study is preadolescence dealing with ages of approximately nine through twelve. This is the period before puberty.

Physically, preadolescence is a time of growth spurts. (13) There is an alternation of low and high plateaus of general growth. Children experience a large increase in growth of bones and muscles which make them awkward. Girls enjoy a brief period of physical superiority, maturing more rapidly than boys. Children learn new motor patterns. (1) All in all, this is a relatively healthy period for children. (49)

Specific parts of intellectual development are beginning to emerge from the former pattern of general development. (1) Lipovitz quotes Wood and Cassidy who say that one of girls' mental characteristics is their creative imagination and high mental powers which need exercise. (8)

This becomes a time of restlessness and rebellion for children. (49) They are trying to gain freedom from parents and

discover their own role in the world. (1) The gang instinct is high and they like to form secret clubs. It becomes important to be accepted by one's peers. Even though children are going through this period of self-assertion, they still rely on their parents and their love and approval. At this time, too, the boys and girls are not wanting anything to do with each other, or so they say. (49) Preadolescents are more able to extend themselves in work and for longer periods on a project. They develop more interests, many outside of the school. (13) There is a marked growth in self-concept. (1)

Physiology of Children

Blood pressure. Blood pressure has become a popular physiological measure because of recent methods that make it relatively easy to take and because it assures a fair amount of accuracy. It is known that systolic pressure increases as a child grows from infancy to adolescence. However, there is disagreement on the way the increase occurs. Most observers believe that the increase is gradual but steady until adolescence. (10, 16) Others state that there is a steep increase during early childhood (four to six years). (7, 16) Then, again at preadolescence (nine to eleven years), there is a more rapid rise in blood pressure. (12, 16) Concerning diastolic pressure, most observers believe that it increases proportionately with the systolic pressure. (16)

It is difficult to give an average blood pressure reading for children because figures from various studies seem to differ widely. During the first year of life, McCurdy and Larson put a

baby's blood pressure at 70-85/60 mm. (10) At four years, Morehouse and Miller put it at 100/67 for boys and 100/64 for girls (12); Kerley records 80-100/50-70 on an average for three to six-year-olds. (30) Blood pressure during childhood (six to ten years) ranges from 80 to 119 for systolic and 50 to 70 for diastolic depending on the source. The White House Conference report stated 100/70 as blood pressure for ten-year-olds (16); Graham, Hines, and Gage reported the following for both sexes: 90-94/50-54, six years; 100-104/50-54, seven years; 105-109/55-59, eight and nine years; 110-114/55-59, ten-year-olds. (23) Data collected for only girls give these blood pressure readings: 100-109/50-59, seven, eight and nine years and 110-119/50-59, ten-year-olds. (23) Lowrey and Watson give 95/70 for eight and ten-year-olds (9); Morehouse and Miller give 103/70 for ten-year-olds. (12) It must be remembered, however, that each child develops his own pattern. His blood pressure may change greatly from day to day and fluctuate from year to year. (22)

Researchers have observed many factors to see which ones affect blood pressure. One such factor was sex. The majority of investigators have found little or no differences in blood pressure between the sexes until preadolescence. (11, 16) Between ten and thirteen years of age, girls exceed the boys. From thirteen on, the blood pressure of boys climbs more rapidly. By late adolescence, it is considerably lower in girls. (11, 12, 16) Young women are typically eight to ten mm. Hg. less than young men of equivalent age in blood pressure readings. (3, 12)

Height and weight of children have been considered as possible factors affecting blood pressure readings. However, Downing comments that differences in height and weight for a certain age have little affect on blood pressure in a healthy child. (9, 16, 22)

Another factor that affects blood pressure readings is the position of the subject at the time of testing. The White House Conference of 1933 states that observers concluded that systolic pressures in children are highest in a reclining position, lowest in a standing position, and somewhere in between while sitting. (16) However, Karpovich writes that no general agreement has been reached concerning relative values of the brachial arterial blood pressures in the lying down or sitting up positions. Evidence shows that a "healthy man in the standing position may have a blood pressure either higher, lower, or the same as in recumbency." (7:18)

McCurdy and Larson measured blood pressure of Olympic swimmers and Springfield College varsity swimmers. The following results were found:

> The mean sitting systolic blood pressure of 40 American Olympic swimmers was 121.90. The mean pressure for 60 varsity swimmers was 124.07.
>
> The mean sitting diastolic pressure of 40 Olympic swimmers was 70.10. The Springfield College varsity swimmers had diastolic pressures somewhat higher; mean-78. (10:246-7)

Other factors which may affect children's blood pressure readings include their physiological condition, the size of the cuff of the sphygmomanometer and the emotional anticipation of testing.

The effect of exercise on blood pressure has been studied with adults quite profusely, but there is little information for those under the age of adolescence. In general, blood pressure increases greatly during physical exertion. Diastolic pressure may rise some but the greatest increase is in systolic. Exercises dealing with strength cause the blood pressure to rise rapidly to a great height; it drops rapidly again upon stopping the exercise. Exercises of speed cause the pressure to climb less rapidly and return to normal more slowly. Endurance exercises do not raise blood pressure readings as high as the other two types of exercises. Often blood pressure may be below normal at the end of exercise. (10)

Very little or moderate exercise may not affect the systolic; after a slow walk, a slight fall may be seen. As the exercise becomes increasingly strenuous, the systolic pressure rises. (12)

Bowen conducted some of the earliest careful studies on the change of systolic pressure during work on a bicycle ergometer. He

> . . . observed a rapid rise in pressure at the beginning of exercise followed by a more gradual secondary rise to a maximum that was reached in five to ten minutes. The pressure then remained fairly steady although it showed a slight tendency to fall during the remainder of the exercise period. An abrupt fall almost to resting level took place as soon as the exercise ceased. The heart rate increased more abruptly at the beginning of exercise than did the blood pressure but returned to normal more slowly after exercise than did the blood pressure. (12:125)

Of all the studies consulted, those most closely related to

swimming are those dealing with running or speed exercises. However, it is dangerous to try to apply the conclusion of those studies performed on adults to children. It is obvious that more research needs to be done with children under the age of adolescence.

Pulse rate. The second physiological measure used in this study was pulse rate. (The terms pulse rate and heart rate are used interchangably.) Whereas, blood pressure increases from birth to adolescence, pulse rate decreases progressively during childhood. However, the rate of decrease is not constant. Vierordt and Tigerstedt indicate that the most noticeable decrease in rate occurs the first three years and that a steady, more gradual decrease continues until eighteen years old when the adult rate is reached. (16)

The average heart rate of a baby from birth to first year is 130-150. (9, 10) From two to four years, the heart rate decreases to a range of 90-110 according to Lowrey and Watson. (9) For childhood (about six to ten years), the range is 90-100. (9) Karpovich cites Vierordt from Daten und Tabellon on heart rate of preadolescents as follows: six-seven years, 92; seven-eight years, 94.4; eight-nine years, 88.8; nine-ten years, 91.8; and ten-eleven years, 87.9. (7)

The factors influencing a change of pulse rate are much the same as for blood pressure. There seems to be no real difference between sexes under conditions of total rest. But under standard conditions, girls' heart rates are slightly higher.

Women, in basal condition, have pulse rates seven to eight beats higher than men. (7) DeVries, as well as Morehouse and Miller, say women have rates five to ten beats higher than men. (4, 12) Burlage (18) and the team of Stocks and Karn noted that during puberty pulse rate decreases in girls. (16) It should also be noted that athletic women have a slower normal heart rate than the nonathletic. (10)

It is generally professed that size and weight of children is a factor in determining heart rate. However, evaluation of the topic leads to the conclusion that this has not been decided. It is even questionable if the subject is really important enough to continue investigations. (16)

As in blood pressure, the position of the subject also has an effect on heart rate. Rates taken in a standing position are highest; sitting are the next highest; and lying are the lowest. (16)

Pulse rate is affected more by variations in the emotional state than in postural changes. The fact that emotions speed up pulse rate makes it very difficult or impossible to get a normal resting pulse rate. The subject may appear relaxed and yet the pulse rate is going up. As simple a matter as waiting for a test may greatly affect the rate of the pulse. (7) "Dill found a mean increase of nineteen beats per minute in the resting rate of teenage boys waiting to be tested in his laboratory." (4:71-2) DeVries writes of a study by Wolf:

> The effect of emotional excitement is most easily observed at rest, but it also occurs during exercise where it tends to result in an excessive cardiovascular adaptation. (4:71-2)

In a study by Antel and Cummings, evidence is given that emotional factors significantly change results of submaximal work tests based on pulse rate alone; also, evidence is given that exercise heart rate of 170 beats/minute may increase more from emotion. (17)

Collecting a reliable resting pulse rate in children is much more difficult than obtaining one from adults. Children are more excitable and usually restless while waiting for examinations. They often start playing and fighting with each other. (7)

Next to be considered is the effect of exercise on heart rate. Of course, it would be expected that exercise would be the greatest factor in increasing heart rate. One should be careful to get a true resting pulse when taking pulse rate in a state of rest before a contest. In what might seem like apparent rest conditions, athletes sometimes experience a "start" pulse or anticipatory heart rate stepped up by the excitement of anticipation. (7)

The three types of exercises have different affects on heart rate also. Speed exercises cause the largest increase; strength exercises give the smallest pulse rate; endurance exercises increase the heart rate more than strength but less than speed. (10)

When muscular exercise begins, pulse rate increases rapidly. Bowen outlines the three well-marked stages as (a) primary rise, (b) plateau, and (c) secondary rise. (10) The greatest increase comes within one minute of starting. Sometimes within the first fifteen seconds, one-half of the increase will occur. Gradually, a plateau is reached. Occasionally, a secondary rise may be noted if exercise is intensive. (7, 12) However, one must realize that changes in pulse rate are peculiar to each person. (7) There is really no such thing as normal heart rate. Averages may be given but another higher or lower number may not be abnormal for that person. (4)

Not only is there a pattern for increasing pulse rate at the beginning of exercise, but also for the return to normal. It decreases almost as rapidly as it increases for the first two or three minutes after exercise has ended. After this initial rapid decrease, continued decline in heart rate takes place more slowly. (4) Along these same lines, Bowen has found in his studies,

> that a sudden and rapid primary fall of pulse rate may at times be followed by a plateau or constant rate with a subsequent slower secondary fall. The pulse rate occasionally may fall below the pre-exercise level. (7:171)

The decline in heart rate takes place at a rate related to intensity and duration of work. (4) Karpovich concurs with the fact that heart rate is dependent on the intensity of the exercise and upon the individual's condition. The time required for recovery increases as the intensity of the exercises increases. (7, 12)

With a light workout, heart rate drops rapidly after exercise stops and reaches normal in seconds.

> The physiological responses of young women to moderate exercise do not differ sufficiently from those of men. . . . There is a somewhat greater increase in heart rate in women than in men, but this merely limits the maximal severity of exercise that can be tolerated. The endurance of women is also usually less than that of men in comparable health, but there is considerable overlap between the more fit women and the less fit men. (12:297)

After exhausting muscular work, a longer interval of time, an hour or more, may be needed for heart rate to return to normal. (8) Besides intensity and duration of work, Karpovich states that better physical condition tends to shorten recovery period. (7) McCurdy and Larson agree. They write that the time it takes for a pulse to return to normal decreases with training. Small amounts of speed and endurance exercise cause a more rapid return to normal heart rate. A delay of return to normal is in proportion to the severity of the exercise. Athletic training, generally, produces a lower normal heart rate of four to eight beats less than the average. (10)

Heart rate of championship swimmers was taken by McCurdy, Larson, and Wilson. They found the mean normal standing pulse rate of forty American Olympic swimming candidates in training to be 81.30. In another study of sixty Springfield College Varsity swimmers, the mean was 83.60 in mid-season condition for swimming competition. Swimmers have a more rapid return of pulse rate after exercise than non-swimmers. (10)

Studies about running may, for the most part, be applied to other methods of locomotion such as swimming. For example,

Karpovich writes of the studies by Liljestrand and Stenstrom who showed that in running at relatively low speed, the pulse rate was greater with increase in speeds at the end of running. One would expect the greatest rise in pulse rate after fast sprinting because of the intensity of effort is greatest. However, this is not true probably because the time of running is too short. This can be applied to swimming also. (7)

One factor that changes from land sports to aquatics is the totally different environment.

> Under ordinary conditions the direct contact of the body with the water of varying temperature affects all bodily functions more profoundly than air environment. (10:244)

In land sports, the body is protected from air changes by clothing but this is not possible in water. (10)

Respiration rate. Infants breathe largely with the diaphragm and continue until the fifth to seventh years of life, when the costal element begins to take over. "The rate and depth of breathing are extremely variable in infancy, and the younger the subject the greater the possible variation." (9:156)

Lowrey and Watson list the respiration rate of a newborn as 30-80 per minute. At one year of age that decreases somewhat to 20-40 per minute. By the time the child is three to seven years he is breathing 20-35 and from eight to fourteen 18 per minute, almost the adult rate. (9)

Merry and Merry list the following averages for rate of breathing divided between boys and girls:

Birth through first year -	30	inspirations per min. -	girls
	31		boys
Between 5 and 6 years old -	21		girls
	22		boys
Between 9 and 10 yrs. old -	19		girls and boys

(11:123)

As an exercise begins an immediate increase of breathing occurs. There may be an increase in breathing just before work starts which is due to anticipation when the excitement of competition is added. Two phases to respiratory response are present for a given work load. There is a rapid initial increase followed by a slow rise to the final point where it remains throughout the exercise. (12)

The amount of time necessary to return to the preexercise breathing level is dependent on the severity and duration of the work. The time lapse is determined also by the physical condition of the subject. (12)

An ordinary adult who is untrained averages a respiratory rate of approximately seventeen to eighteen per minute. Women have a slightly faster rate than men. The rate of breathing is increased by standing and by muscular exercise. (10)

One of the things that affects a change in respiration rate is training. Continued training in muscular exercise seems to reduce respiration rate. Clinical evidence points to the fact that trained individuals have a slower and deeper respiration. The rate of return to normal was more rapid with athletic than non-athletic people in one study. (10)

The most frequently observed upper limit of the respiratory rate during activities is about thirty per minute on land. In

swimming the rate often rises as high as sixty probably because swimmers try to breathe with each stroke.

There are two important aspects to swimming ability. These are efficiency of the respiratory system and mechanics of respiration. Through Cureton's work the discovery was made that there was an interference of respiration by (a) simple immersion in water without swimming, (b) swimming various strokes, and (c) maximum speed with the racing strokes. Marked irregularity of respiratory movements were experienced by just being in water. Three things occurred. First, the rhythm and depth of breathing changed, rate of breathing increased, and a slight loss of vital capacity took place. Apparently the changes happened because of the reflex effect of cold water. According to Cureton, other factors that disturbed respiration were added water pressure on the body, interference from nasal expiration and interference from stroke mechanics. (21)

Grip strength. Man's strength continues to increase until twenty-five years of age. It is maintained at this level for five to ten years and then starts a gradual decline throughout the rest of life. Physical exercise can delay the decline. Both sexes have about the same relationship between strength and age. Strength as related to the two sides of the body shows only a slight difference. After a single maximum effort of strength, recovery probably takes place in less than ten minutes. (24)

Greey and Hunsicker report a longitudinal study done by Jones which extended over seven years and involved ninety-three boys and ninety girls. Jones came up with the following generalization:

1. Approximately 4/5's of an adult's strength but hardly more than 1/3 of his height is acquired after the age of six.

2. Few girls improve in tests which involve vigorous movement of the body, as a whole, and many exhibit an actual decrease after the age of thirteen.

3. Whereas, the boys' strength veers upward after age thirteen, that of girls' lagged behind in each function; this lag was so great that by 17.5 years, the difference between the means for boys and girls was approximately three standard deviations in terms of the variability of the boys' scores, and approximately four standard deviations in terms of the variability of the girls. (24:111)

Emotional Stress

Hans Selye, the Canadian who developed the prominent stress theory, defines stress as "the state manifested by the specific syndrome which consists of all the nonspecifically induced changes within a biologic system." (15:54)

Stress develops through bodily changes which come about by physiological or psychological conditions that tend to create a homeostatic imbalance. Researchers neither fully understand how this occurs nor whether exercise may elicit some features of the alarm reaction. According to Selye's theory "a stressor produces a generalized stress reaction in the body through either neural or hormonal pathways." (12:285) It is theorized that exposure of the body to a given stress may result in the body learning to adapt to withstand that stress.

> It has been suggested that exercise may act to stabilize the homeostatic balance by providing a means of offsetting the physiological consequences of emotional stress. (12:286)

Michael theorizes that exercise may increase the size and lower the threshold of the adrenal glands. This results in a greater reserve of antistress steroids and less response time to stress. However, evidence is lacking. (36)

Somewhat opposing this idea, Bannister believes men expose themselves voluntarily to the strain of sport in order to dissipate inner tensions. In his opinion, it is not wise to try to draw too close a parallel between stress from athletics and the type of stress studied by Selye. Bannister suggests that Selye's stress ideas may simply be a common feature in several different diseases. (12)

"An explanation of physiological processes that underlies the stress response of athletes in competition has been offered by Russian students of physiology of exercise." (12:286) Instead of hormonal mechanisms, their explanation is based on Pavlov's doctrine of higher nervous activity. Their approach is that a conditioned reflex regulation of body functions in exercise explains the stressful effect of competitive conditions in athletic activities. (12)

The competitive situation becomes a conditioned stimulus which causes body activities to increase even before the event starts. These upsurges in body functions before an activity are called prestart increases. They can be stopped by discontinuing preliminary exercises, warm-up activities, before contests. Sometimes when preliminary exercises had been habit before competition, functional depression is seen in place of the prestart elevations in function. (12)

Russian research suggests that the competitive setting influences the state of the organism before the start, during the period of the effort, and in the recovery phase after its completion.

> This theory has been used to explain various peculiarities of function regulation in athletes, such as in individual differences in cardiovascular response. Greater increase in pulse rate and blood pressure are found among individuals of the 'weak' or 'quiet' type due to their higher nervous activity according to Pavlov's classification. The 'active' or 'unrestrained' athletes do not overreact this way and perform better than the former group in important competitions such as the Olympic games. Training does not reduce the prestart responses; in fact the 'weak' type tends to get worse. (12:287)

Age is a factor in prestart reactions. Adolescents show higher reactions than adults. A possible answer is that overreaction may be attributed to the increased excitability of the growing individual especially in the period of sexual maturation. Functional efficiency is less during adolescence than in adulthood. (12)

Organized Competition for Elementary Children

No one denies that competition is beneficial in the growth and development of children in order that they may become well-balanced, responsible adults. However, that is where agreement ends. There are very divided opinions about level and intensity of competition in which children should become involved at different developmental stages. The most arduous disagreements center on the question of highly organized athletic competition for children under thirteen years of age. (39)

Reichert defines highly organized, highly competitive athletics as

> . . . sports which are played by teams that have been developed through a series of elimination games and which represent a school or a community in championship schedules of interschool, intercommunity, regional, or national games or tournaments. (39:1702)

The School Health Committee of the American Academy of Pediatrics defines highly competitive athletics as

> . . . competition in which the chief stress is placed on winning, with excessive emotional pressures applied by teachers, parents, and others, and by parental interest going to the point of expressing undue concern over winning. (39:1702)

There are generally two schools of thought concerning the question. There are those who believe in competition but place limitations on the intensity and scope of competitive athletics for young children. Included in this group are the majority of educators and physicians who have studied the problem. (39) For example, in 1968 the Joint Committee of the American Association for Health, Physical Education, and Recreation and the Society of State Directors of Health, Physical Education, and Recreation made the following statement in a report on Desirable Athletic Competition for Children of Elementary School Age:

> Educators for the most part have maintained a conservative point of view, raising doubts about the wisdom of encouraging athletics of this type (interschool, interagency, and Little League type athletic programs) for children of elementary school age. (48:1)

But there is general agreement among educators that

> . . . properly supervised athletics can play an important role in the education of children and youth and that athletics should be an integral part of the school physical education program. (48:1)

On the opposite side are those who feel that highly organized, highly competitive "varsity-type" athletics are a desirable activity for children in their early school years. Included here are sports promotors, professional athletes, sports fans, and some coaches. (39)

Somewhat in between these two camps are the parents. Some would like to develop an athletic star in the family and they go to the side of the latter group; those who are concerned for their children's safety side with the first group.

The types of athletic programs being offered to children can be classified in one of the following ways:

1. programs that are part of the regular school curriculum;
2. programs that are outside the school curriculum but are a part of the community recreation programs;
3. programs organized under independent, specific interests related to specific sports or to specific sponsors;
4. unorganized, pick up activities, such as 'sandlot' and 'scrub' games. (39:1701)

School athletic programs are most easily regulated. But the basic problems of athletic competition for youth are common to all types of programs and in particular to the third and most rapidly growing group. (39)

The basic problems center around the following questions:

1. How does organized athletic competition affect the physical growth and development of elementary school age children?
2. What is the likelihood of injury and what are the possible after effects?

3. How does organized athletic competition affect elementary school age children psychologically and emotionally?
4. What does early specialization do to a child as far as his later feelings for a sport?
5. What kind of leadership should be working with organized athletic competition programs?
6. What affect does organized athletic programs have on presently established programs?

Various views expressed on the first four areas will be presented.

Physical growth and development. Results by Rowe (41), in an early study, and by Fait (48), in a later study, gave an indication that growth during early pubertal years is harmfully affected by six months of interscholastic sports. Shuck (44) observed seventh through ninth graders and found no difference in growth trends of those playing interscholastic sports and those who were not. He did write of an apparent retardation in growth of seventh and eighth grade boys who played a 17-game season as compared with a 12-game season. Studies of this kind should be viewed with suspect since athletic participants seem to be bigger, more mature, and faster growing, or in other words, not the typical boy.

Astrand has done one of the most complete studies on effects of training and highly competitive athletics on growth. His longitudinal growth data on thirty girl swimmers aged seven to sixteen years "showed clearly that the growth curves of these girls were

normal throughout this period, being somewhat accelerated above normal during the training years." (48:17) The majority of swimmers had started heavy training before the age of thirteen, and some as early as ten years. Two years after the investigation, medical examinations showed no harmful effects of the training program. (48)

Evidence is showing that physical maturity in relation to chronological age differs in athletes and nonathletes. Hale (26) and Krogman (31), who worked with participants of the Little League World Series in 1955 and 1957, found that the boys were more mature anatomically and physiologically than the average boy. The work of Clarke and his co-workers supports these findings. (19, 20)

Research to date provides little supporting evidence to the belief that demands imposed by competitive sports has a harmful effect on physical growth. Based only on the effect of a lifetime of strenuous activity upon physical growth, evidence shows that, on the whole, the body benefits from such programs. The big question is what quantity of physical activity is either maximum or excessive in supporting physical growth? "The safe answer is that it varies with the maturity level of the child, with the child's constitutional make-up, and with his state of health." (48:18) Some evidence points out that excessive weight bearing during growth years, while stimulating growth in bone diameter, may result in some retardation in long bone growth. Perhaps the key factor concerning physical growth is not "whether the athletic activity is intra- or interschool but the conditions under which such programs are conducted." (48:18)

One argument against athletics is that "stresses of varsity type sports may result in overexertion with resulting damage to the vital organs." (48:19) Only limited research has been conducted on children to study physiological responses under conditions of extremely heavy physical exertion. One such study was conducted in the early 1920's when Seham and Egerer-Seham worked with children six to fifteen years of age on a bicycle ergometer. There was no acute dilation of the heart in any children and all recovered within a few hours. However, nausea following exercise was characteristic of the group. (42) Competitive contests of today hardly ever place this great a demand on children. Morse and Schultz took boys ten to seventeen years of age and ran them to exhaustion on the treadmill. They found that the older boys were more able to sustain exhausting exercise than the younger ones. (37) Adams and others showed, through their experiments with boys six to twelve-years-old, that working capacity increases almost linearly with age and changes in body size. There is still much to be learned about the exercise tolerance of children and the long lasting physiological effects. (48)

Evidence is lacking to confirm that strenuous physical activity in competition or noncompetition has had harmful effects on physiological mechanisms of healthy boys six to thirteen years of age. While evidence shows that vigorous physical activity is beneficial for young boys, "there is no data concerning the long-range physiological effects of competitive athletics for youth." (48:20)

Injuries. The second question considers injuries that might be sustained in competitive athletics. Whenever children get together to play vigorous physical activity, injuries are always possible. The chances are increased under highly competitive situations. Dr. Reichert writes that "preadolescent children are in a vulnerable age." (39:1703) Periods of rapid growth, with temporary maladjustments and weaknesses occur at this age. One example is bone growth. It is more rapid than muscle development, so that, for a brief time, the bones and joints lack the natural protection of covering muscles and supporting tendons. During these periods, children are especially susceptible to dislocations of joints and to bone injuries especially to the epiphyses. These kinds of injuries can cause permanent damage and interfer with normal growth. (39)

Dr. Lowman sent a questionnaire to about 400 orthopedists asking about injuries to bones and joints. About 75 per cent supported a statement made by State Directors of Health, Physical Education, and Recreation purporting "that interscholastic athletic competition was not good for young adolescents and that body-contact sports should be eliminated." (34:636)

Many authorities believe the heart might be in danger from too much exercise. They believe that "violent and sustained exercising and the bruising and fatiguing activities of strenuous competition" (39:1703) may throw a harmful overload on the immature heart, lungs, or kidneys. Damage may not be evident at the time but may show up weeks or years later. (33) Reichert writes that

evidence to the contrary, which he has found in literature, is not well controlled or impressive.

Karpovich re-evaluated data of a previous investigation that indicated the aorta and pulmonary arteries did not keep pace with the heart in the growth rate of children. When the data were re-evaluated, it showed a parallel growth rate and no need of special consideration for vigorous exercise. (29) Even though there does not seem to be evidence of injury to the cardiovascular system of children through strenuous exercise, evaluation of competitive athletics for small children must be on other bases also.

Another more subtle type of damage may occur when a child develops one set of muscles over another as he learns the skill in a sport. Usually, "strenuous athletics tends to strengthen flexor muscles at the expense of extensor muscles." (39:1703) A shift in stress and weight bearing is likely which then influences the development of bones to which muscles are attached (Wolff's law). This leads to the possibility of poor posture resulting in a skeletally maligned individual. (39)

There is a real danger that fractures take place and are not reported. Foster cited fourteen cases where high school athletes suffered fractures which were not diagnosed until X-rays were taken. Many fractures were not reported by players for fear of being called "sissies" by teammates and coaches. This type of practice could lead to permanent deformities if fractures involve growing ends of long bones. (39)

In a magazine article by McCarthy, the author mentioned medical reports about Little League pitchers being plagued with

injuries to throwing arm elbows. Apparently, this is caused by too much strain on physiologically immature articulations and musculature. (35)

Knutson did a five-year study of injuries in junior and senior high school physical education classes, intramural sports and interschool athletics. He found

> that the number of injuries per student hour of participation was highest among senior high school participants in interschool athletics and was substantially lower at the junior high school level, even though the sports programs were almost identical. (48:20-21)

When the injury ratios for seventh and eighth grade boys in the same three areas were compared, the differences were negligible. This seems to suggest that the injury problem in interschool sports is not a major factor at this age level. There is insufficient evidence, however, to draw a sound conclusion about participants below the seventh grade. (48)

Hale did a five-year study of injuries of Little League baseball players. There was only a two per cent incidence of injuries. The most common injuries were abrasions and contusions (52 per cent) and fractures (19 per cent). The eight through twelve-year-old group had fewer injuries in number and severity than the thirteen-fifteen year-old players. (25)

Skubic also investigated incidence of injury among one hundred Little and Middle League players in California. During the season of league games, there were 69 sprains and 5 broken bones plus 146 bruises and cuts. Out of 60 Little Leaguers questioned, 123 injuries were reported and 19 indicated no injuries. (46)

Anytime injuries during the growing years are discussed, some thought must be given to possible permanent bodily damage. The most frequently mentioned injury is damage of the epiphyses of the long bones. Krogman warns of such damage during pre-adolescent years. (31) In a 1952 study of orthopedic surgeons, 69 per cent would support Krogman's opinion. These surgeons indicated that the years immediately preceding puberty are a time when joints are unusually vulnerable to injury. (48)

Adams has observed throwing arms in Little League players nine to fourteen-years-old. There were injuries to the elbows of all the pitchers but only a small percentage of nonpitchers. This suggests that repeated stress on joint structure during growing years can cause injuries. (48)

Shaffer is not in total agreement with these previous opinions about damage to the epiphysis. He says that "although the epiphysis is potentially vulnerable to injury epiphyseal injuries occur infrequently." (43:97) He feels that there are various other causes besides sports that damage growing bones. Shaffer also points out that orthopedists do not agree that epiphyseal injuries are more prevalent in athletics than in informal play. (43) Larson and McMahon found in a study that only 17 per cent of 371 athletic injuries in boys fifteen-years-old and younger were epiphyseal. They believe epiphyseal displacements can be reduced with little likelihood of permanent damage. (32) Sigmond says the important thing is to be on the lookout for symptoms of bone or joint disease so further trouble can be prevented. (48)

In this area, as in so many of the others reviewed for this study, there is not enough available data. Yet, there seems to be enough that one cannot ignore the injury problem in competitive athletics for youth in the six to thirteen year-age range. Energetic youth of this age will play in unsupervised sports unless challenging supervised activities (school or agency sponsored) are provided. (48) Well-conducted school programs, well-organized summer recreation, and good leadership are necessary for this.

Many are saying that physical and emotional injury could be avoided by pairing opponents equally. But matching opponents means more than using just chronological age or size. There is a wide range of physical and emotional maturation. Pryor and Smith studied girls of the same chronological age but found they differed according to size, body build, and physiological maturity. (38) Even though boys mature later, the same physiological principles apply to boys as to girls. Two boys both twelve years old of equal height and build may be years apart in physical development and, maybe more importantly, in maturity of their judgment. The immature is no match for the mature. The immature will most probably lose and even be badly injured in the process. (39)

In a study by Hale, which has been previously mentioned, the majority of participants in the 1955 Little League World Series were not preadolescent as their chronological age would indicate (ten, eleven, twelve-years) but were adolescent in development. In the elimination games, more often than not, the more mature boys were winning over the immature ones. (26) One wonders if

there really is an equal chance for all to win. As far as matching opponents equally, Reichert says there is no test or set of tests developed yet, that could be used in the gym or athletic field, which will accurately measure the level of a pre-teenage child's physical and emotional maturity in order to match him safely for strenuous athletic competition. (39)

Psychological. Besides the problem of physical injuries, there is the possibility of the psychological and emotional problems produced by competitive athletics. Many medical experts say children of elementary school age are not developed enough physically or emotionally to withstand stresses of keen competition and rivalry. (2)

> Strong emotional reactions are too often engendered by high-pressure competitive games, especially by intercommunity or interscholastic schedules and championships. Such a response occurs not only in children but also in adults. (39:1703)

These over reactions may lead to abnormal psychological responses, both in parents and in children. The following examples of reactions may have profound influences on a child's emotional development and social adjustment:

> hero worship of the star; sense of failure in a boy who does not make the team or who fails to make the crucial point; obvious disappointment of parent when the boy fails or excessive pride and praise when he wins; apparent difference in social acceptance by playmates and adults between winners and losers. (39:1704)

Many harmful results produced by highly competitive sports occur because sports are being organized on an adult level. The parades, uniforms, prizes and other paraphernalia, instead of recognizing the child, are really aimed at the parent who is

vicariously living an experience he may have missed as a child. (39) Administrators of competitive sports need to see boys as boys and not as adults in miniature.

> The superstructuring of childhood with adult standards, values, and aims is totally unrealistic and completely incompatible with the needs, interests, and capacities of this age group. Most of these boys are not mature enough, pyschological or emotionally, to cope with the full-blown adult pattern of success orientation with its tensions and frustrations. (35:80)

The present setup of league standings, trades, all-star teams, tournaments, playing a single position, awards, and publicity fixes in a boy's mind a concept of his own baseball abilities which could be erroneous. This occurs at a time when there may be differences in physiological ages of ten years and chronological ages of only four years. This early assessment of abilities may be harmful in two ways: it gives false values to those who mature early physically and frustrates late maturers. This is bad for late developers who may have the potential to be a great athlete but who may not see it in premature stereotyping. Ability is over emphasized and perpetuated in programs where large portions of money, equipment, facilities, and personal attention go to the best athletes. (35)

Research in this area of the psychological, emotional, and social is extremely fragmentary. The problem is having no accurate method of testing for psychological stress which occurs before, during, and after athletic contests. It is equally as difficult, if not more so, to determine if there is any lasting traumatic effect or if competitive activities are indeed beneficial to social and personality development.

At this time, investigations have not shown that tensions from interschool and agency sponsored leagues and tournaments are any greater than those from interschool sports. Skubic discovered that youngsters aged nine to fifteen years (measured by galvanic skin test) were no more stimulated by competition in Little League play than boys of the same age who were in competition in physical education games. (45)

In a survey of 1,300 physicians who were fathers of Little League players,

> 64 per cent of the fathers felt that participation favorably affected the emotional adjustment of their sons, 33 per cent indicated no noticeable effect, and only 3 per cent specified an unfavorable effect. Some 97 per cent of the fathers indicated that the Little League games did not excite their sons to the point that they adversely affected their health. (48:21)

Such activities may, however, upset normal sleep as indicated by Giddings who reported disturbed sleep following highly competitive contests. (48) Eating habits may be upset following competition as indicated by Skubic's survey. (46)

Johnson did a study comparing pre-game emotional buildup of college football players and wrestlers. He discovered that the football players experienced little emotional buildup just before game time, whereas, wrestlers showed quite a bit of buildup before matches. (28) Even though this study used college age subjects, it is interesting to note the reactions of members of a team as compared with individual sports participants in relation to emotions. This might mean that swimming as an individual sport could cause more emotional buildup prior to performing than Little League baseball.

Playing in competitive athletics may have undesirable psycho-emotional effects but, so far, evidence does not point to this. Other competitive school situations such as academics might also be a cause of psychological tensions.

Specialization. The fourth question posed at the beginning of this section was about what early specialization does to a child as far as his later feelings for a sport. Competition is a part of life whether a child or adult. There is general agreement that children will compete whether or not they are in an organized situation. The main concern is that children who start intense competition around the age of eight-years-old will either "burn out" or lose interest by their mid-teens. It has been suggested, according to Lowman,

> that many potentially good athletes have been ruined by too early competitive sports involving the burn up of reserve power by violent and prolonged athletic activities during childhood and adolescence. (34:636)

Lowman, coaching girls' basketball, observed adolescents suffering emotional collapse after losing a game in which good sportsmanship and pleasure in playing were secondary to winning. "This is an unhealthy and damaging situation." (34:636)

Shaffer gives a second reason for questioning specialization. He writes that the child who finds success in one or two sports may not have the time or encouragement to learn a wide variety of physical activities that he could be sampling. (43)

The third argument against competition at an early age is that someone who starts intensive training at age eight will play maybe six or eight years and then, by age fourteen or sixteen, not want to have anything to do with the sport. Astrand's study

refutes this. The second part of his study was a questionnaire given to eighty-four women finalists in Swedish swimming championships six to fifteen years later. "They had a positive attitude toward swimming, although many questioned the advisability of present strenuous training programs. . . ." (48:17)

Swimming for Elementary School Children

A fair amount of material has been written about swimming. Some of this information deals with competitive swimming of Olympic athletes, college teams, and even some high school swimmers. Very little has been written about swimming competition for elementary aged children. The most directly related article was a piece in the Journal of Health, Physical Education, and Recreation reporting a speech by William Happ delivered at the Aquatics Section of the National Convention in 1967. (27)

Happ is in favor of group swimming programs for boys and girls as long as certain limitations are set. However, he raises several questions about certain policies and practices. The first question he has concerns overworking swimmers. In order to develop champions, coaches and parents both have a tendency to push for increasing work loads, practicing long hours, increasing competitive distances, and using weight training devices. The question is how much can an eight, ten, or twelve-year-old child take physically before something gives.

Secondly, Happ feels that coaches, parents, and swimmers are becoming too conscious about swimmers' times. To improve on times more distances are added, more weight training exercises, more practice hours, more weeks in a season until the child does

not have time for anything else. Swimming may be so overdone that the child "burns out" not physically but rather ceases to have fun and gives it up at fourteen or fifteen years of age.

Happ lists several recommendations. First, he would restrict the program to a summer and winter season of three months each. Secondly, distances would be limited to 25 meters, eight and under; 50 meters, nine and ten; 100 meters, eleven and twelve; 200 meters, thirteen and fourteen. Thirdly, restrict isometric and weight training to fifteen-seventeen years only. Fourthly, restrict interval training to none for eight and under or nine-ten-year-olds; five repeats to 25 meters with two minute rest for eleven-twelve-year-olds; five-ten repeats to 50 meters with three minute rest for thirteen-fourteen-year-olds; no restrictions for fifteen-year-olds and up.

This review of literature has consisted of five sections dealing with the aspects of child growth and development, physiology of children, emotional stress, organized competition for children, and swimming competition for children. There is evidence to persuade one either for or against organized competition for children of elementary school age. For every reason that is given advocating organized competition there seems to be a substantial argument against this type of competition. As far as growth and development are concerned, the debate as to the effect of competition has not been resolved. The physiology of children during heavy exercise, although insufficiently investigated, has not produced any real difficulties so far. Emotional stress in

relation to competitive activities is another area insufficiently covered and difficult to measure. Finally, little is known of the effects of swimming competition on elementary children.

CHAPTER IV

PROCEDURES

This chapter deals with the mechanics of the study. The first aspect discussed is the manner in which subjects were selected. Secondly, the three types of physiological measurements (blood pressure, pulse rate, and respiration) and one performance measurement (grip strength) are examined. The equipment and methods for each are described. Then the implementation of the study is outlined including the organization of practice sessions and competitive meets as well as how the measurements were actually taken. Lastly, there is a description of the analysis techniques used.

Selection of Subjects

The search for subjects began by contacting the Red Cross Director of Water Safety Services. He listed the names of three community pools in the vicinity of The University of North Carolina at Greensboro, which had competitive swimming teams. After talking with the coaches and pool managers of these three places, the Green Valley pool was selected because of the large number of swimming team members and, therefore, potential subjects.

The investigator visited several team practices. Then a meeting was held with girls seven to ten years of age and the study was explained to them. Thirteen girls volunteered to

participate. Letters were sent to the parents giving the purpose of the study and details of the measurements that would be taken. The parents' permission along with a signature were required in order for a girl to be eligible. All letters were returned with permission granted except one which the child forgot to bring back. Out of these thirteen volunteers, data were collected on seven. Three girls were second year veterans of the Green Valley team. The other four were experiencing their first year of competitive swimming. The girls swam in two different age groupings. Four were in the eight and under group and three were in the ten and under group. Five were fairly consistent winners and several were first place finishers. All were eager and cooperative regarding this study.

Measurements

Blood pressure. The equipment used to take blood pressure was an aneroid or spring sphygmomanometer and a stethoscope. The method used was the auscultatory method. The subject sat in a chair with her arm resting on the chair arm, palm facing upward. The cuff of the sphygmomanometer was wrapped around the subject's upper arm so that the bladder was over the brachial artery. The bell of the stethoscope was placed over the brachial artery at the bend of the elbow on the inside of the biceps muscle.

Air was pumped into the cuff until no pulse was heard and the mercury registered 10 mm. above the expected pressure. Pressure was immediately but slowly released. The first sound of blood

spurting through, the pulse sound, was recorded as the systolic blood pressure. Air continued to be released until the sounds became faint and disappeared. This was recorded as diastolic blood pressure. Blood pressure was written with systolic pressure recorded over diastolic pressure, for example 120/80 mm. Hg.

Pulse rate. The only equipment used for taking pulse rate was a wrist watch with a sweep second hand. Pulse rate was taken with the subject sitting down, arm resting on a chair arm. The rate was taken at the wrist in the radial artery and the count taken manually. When it was not possible to find the pulse in the wrist, the carotid artery in the neck was used. Pulse was counted for fifteen seconds several times. These fifteen second counts were multiplied by four to determine a pulse rate for one minute. Then these rates were averaged.

Respiration rate. The equipment used was a watch with a sweep second hand. Respiration rate was taken by observing and counting the up and down movements of the subject's chest for fifteen seconds. The number obtained was multiplied by four in order to get the rate for one minute. Some subjects became nervous while they were being observed. In these cases, the subject was given the watch to do the timing to divert her attention from being observed.

Grip strength. Grip strength was measured on a grip dynamometer. The subject rested her arm on the arm of the chair. She held the dynamometer in the hand which she used the most and then squeezed. The number on the gauge where the needle stopped

was the poundage recorded. Three trials were given. Later the figures were corrected according to the true values of calibration for the particular dynamometer used. Then the converted figures were averaged to find the final score in pounds.

Implementation

The basic plan was to take the four measurements on the subjects at three different times: (a) before and after a practice session, (b) before and after a competitive race against another league team, (c) before and after a competitive race in the Community Swim Association City Meet. There was also the opportunity to take measurements before and after time trial races for the City Meet so these measurements were added as a fourth competitive situation.

Procedure during daily practice sessions. The investigator visited the pool during practice sessions to become acquainted with the girls and the setup. The girls' team practiced Monday through Friday from 8 AM. to 9 AM. except on July 4. Also, an extra practice was added on Saturday, July 19, before the Community Swim Association City Meet on July 22 and 23. The first measurements were taken on June 30, 1969.

A typical practice session for the eight-year-olds and under consisted of warming up by swimming one lap each of the breaststroke, back crawl, freestyle, and butterfly. The distance of one lap was from 10 to 15 meters. Some days after this warm-up period, the girls worked on individual strokes without supervision. Other days, there was a girl who assisted the coach by

working with these younger swimmers on their racing times and breathing.

For the nine-ten-year-olds and the upper levels, warming up meant two 25 meter laps of the four strokes previously listed. After the warm-ups, individual strokes were stressed. The most common type of workout was swimming sets of three or five laps timed with only about twenty seconds rest between laps and swimming the last lap at top speed. The girls were divided into age groups to do this. Between each set of laps, there was time to rest before starting with another stroke.

Measurements were taken at pool side as the subject first arrived in the morning before practice started. At the end of practice, approximately an hour later, the measurements were repeated. The girls were allowed to "play" with the instruments so as not to fear them. Most had been exposed to them when having physical examinations by their doctors. All measurements were taken while the subject was sitting down with her arm in a resting position.

It was possible to measure only two girls a day because there was only one person and one set of instruments to do the testing. On three occasions, however, another person was solicited to help in an attempt to get more data.

Time trials were held during practice the day before a competitive meet. The girls with the top two or three times were the ones who swam in the meet. On the day of a meet, a very light practice was held. Emphasis was placed mainly on starts

and turns. The day after a meet was either a light practice or a playday for team members.

Procedure during a competitive meet. Greensboro has fifteen swimming teams divided into three leagues according to ability. Green Valley was in the top league with four other teams. There was one competitive meet each week except for one week when there was a bye. Out of their four meets, Green Valley won three in the summer of 1969.

The events included races for individuals in butterfly, breaststroke, back crawl, and free style. Also, there were medley and free style relays. The distance of a race for eight-year-olds and under was 25 meters; for nine-ten-year-olds and older, the distance was 50 meters. A meet consisted of races in each event for boys and for girls by age groups which totaled around sixty events in all. A child might swim in four or five events in an evening.

Team members arrived a half hour before a meet was to start. At this time, measurements were taken on certain subjects while they were still in somewhat of a state of rest. Before a meet, it was observed that the girls between the ages of six and eleven or twelve displayed a great deal of excitement and enthusiasm. They did a lot of running around which could account for certain rises in measurements. Measurements were taken again, as nearly as possible, before and after a specific race. However, the timing was most difficult. Often, so much time elapsed that factors, such as respiration, had time to return to normal.

Procedure during time trials for the Community Swim Association City Meet. At the end of the summer, all the community pool teams came together to compete in a city swimming meet. This meet was held on two days with half the events run each day. During the morning and afternoon, time trials were held and the winners competed in the evening of the same day. At these time trials, the investigator collected measurements on two subjects. The same procedures were followed as those used at a regular league meet. The investigator took measurements as soon as possible before and after the subject competed in a time trial race.

Procedure during the Community Swim Association City Meet. A city-wide swimming meet was held for two days at the end of each summer when league competition had been completed. All of the city's teams competed together. In 1968 and 1969, Green Valley won second place in these city meets. The investigator followed the same process for gathering data as was used during a regular league meet.

Analysis of Data

Since the data collected were limited and scattered as to age and events, the usual statistical approach to analysis was discarded for a descriptive approach. Two avenues were followed. First, limited case studies directly concerned with each subject's swimming and competitive experiences were written. Second, tables were drawn to show the data on individual swimmers.

CHAPTER V

CASE STUDIES

The subjects for this study were seven girls from the Green Valley Swimming Team in Greensboro, North Carolina. The study was limited to girls in the seven to ten year age range. After the study was explained, volunteers were accepted.

Three girls were swimming competitively for the second year and four were swimming for the first time in competition. Four girls were in the eight and under group and three were in the ten and under group. All six competitive events were represented by the seven swimmers: butterfly, freestyle, breaststroke, backstroke, medley relay and freestyle relay.

The limited case studies to follow deal only with the subjects' swimming and competitive experiences and other related information. The subjects are discussed in the order of their age from youngest to oldest.

Along with the descriptive information are tables showing the measurements taken of each subject. The measurements include three physiological functions, blood pressure, pulse rate, respiration, and one performance level measure, grip strength. The tables also indicate the four situations in which the measurements were taken. These were swimming practice sessions, a race during a competitive league meet, time trials for the Community Swim Association City Meet, and a race during the City Meet. Each

situation had a little more of a competitive element than the previous one.

The data were considered in three ways. First, the measurements for each physiological function taken before a competitive situation were compared with measurements taken after the situation to see if the physiological function decreased or increased. Second, all the physiological measurements taken before each situation were compared to see if the level of competition affected the scores. Third, all the measurements taken after each competitive situation were compared to see if the type of competition affected the scores of the physiological functions.

The data are scarce and scattered. Some subjects were measured more often than others. Some subjects were measured under more circumstances than others. Two subjects had measurements taken in four competitive situations, two had them taken in three situations, two had them in two situations and one had scores in practice sessions only. A summary of the data for each individual case is written. At the end are summaries on each physiological function and performance level comparing all the cases to see the overall effects.

Case #1

Subject #1 was seven-years-old and going to enter the second grade in the summer of 1969 when the study was conducted. She had learned to swim at age four from a swimming coach and was swimming competitively for the first time. The events in which Subject #1 swam were the butterfly for individuals and the

butterfly in the medley relay. She was a fairly consistent winner taking many first and second places. The subject decided to join the team after hearing about it from her sister who also swam for Green Valley. The parents attended at least two swimming meets including the city meet to the knowledge of the investigator.

When asked by the investigator if she got nervous or upset before a meet or a particular race, Subject #1 replied, "Not often." The swimmer's other activities included tennis lessons and Brownie Scouts. Subject #1 was enthusiastic about her competitive swimming. In a follow-up inquiry, it was discovered that the subject was swimming for the second year during the summer of 1970. She did not swim year around but just during the summer season.

The author's observation of the subject was that she was mostly a quiet child showing little emotional response outwardly. She gave more articulate answers to the questions of the investigators than the average seven-year-old.

Table I shows that Subject #1 did not have as many measurement scores as some and did not have any for the time trials of the city meet. However, Table I shows measurements taken for two races during the same competitive league meet. The systolic blood pressure measurements taken before and after practice, a league meet race, and a city swim meet race showed an increase each time. The systolic blood pressure scores, taken before each level of competition, started at a point above the previous level. This was also true of the systolic blood pressure scores taken after each

TABLE I

MEASUREMENTS FOR SUBJECT #1

Measurements	Practice	Competitive meet: first race	Competitive meet: second race	City-wide meet: First day
Blood Pressure				
Systolic - before	- - 84 88,	100 100,	110 100 100	104 108 104
Systolic - after	110 110, 94 94	100 100,	102 102	110 110
Diastolic-before	- - 40 50,	56 54,	70 70 70	58 60 56
Diastolic-after	58 50, 58 56,	50 50,	54 54	60 50
Pulse Rate				
Before	- - 96	100 104	104 120	108 116
After	88 80, 112	120	104 112	120 124
Respiration				
Before	- , 20	28	32	36 32
After	32 , 24	28	40	28
Grip				
Right hand - Before	- - -, 18 20 16,	18 25 17	24 19 12	20 20 20
After	21, 17 17, 19 16 16,	20 20 19	17 17 17	18 13 5

NOTE: The numbers between commas represent the number of measures taken at one time on one day.

situation. The one exception was the first race of a league meet in which the systolic remained the same.

In comparing the before and after measurements of the diastolic blood pressure, there was an increase following a practice session. However, the diastolic decreased after two races in a league meet and in a race in the city meet. The measurements of diastolic blood pressure taken before the three levels of competition showed an increase each time except one. In comparing the scores before the first and second races in a league meet, there was a fifteen point increase. Comparing the figures from the second race with those from the city meet, there was a sharp drop but still an increase over measurements from the first league race. The diastolic measurements taken after a practice session were higher than those after either races of the league meet or the city meet. There was a slight increase from the two races of the league meet to the city meet.

The pulse rate of Subject #1 increased from before to after each situation of competition except the second race of the league meet. A steady increase was shown by pulse rate taken before the start of each situation. The measurements taken after competition levels were up and down. Scores increased from practice to first race of league meet. From the first race to second, there was a drop and from the second race to the city meet race there was a rise in the after scores.

Respiration rates before and after practice showed an increase. It remained the same before and after the first race

of the league meet. Respiration increased after the second race of the same meet. However, respiration rate dropped after the city meet racing competition. There was a continuous increase in scores before practice through city meet race before scores. The measurements after the first race were slightly higher than measurements after practice. The difference in after scores between the first and second races showed a great increase. And the scores after the city meet race were the same as after the first race of the league meet.

Grip strength went down after each level of competition except for the first race where it increased slightly. There was no particular increase in the measurements taken before each situation, but those taken before the first and second races of the league meet were slightly higher than practice sessions or city meet measurements. This was true, also, of the after measurements.

In a situation where two races were swum in the same night, the physiological functions seem to increase sharply from first to second race. On the whole, Subject #1's functions increased with the intensity of competition. There were no apparent physiological ill effects from participating in competitive swimming.

Case #2

Subject #2 was eight-years-old and entering the fourth grade after the summer of 1969. This swimmer learned to swim at age four through private lessons and was competing for the first

year. The breaststroke was the specialty of Subject #2. Although her body build was on the stocky side, she was strong and usually placed in a high winner's position.

The subject appeared very excited at the swim meets, but, according to her own admission, she was only a little nervous before a meet or race. The parents attended the swimming meets. The mother talked to the investigator and showed much interest in the study.

The subject enjoyed competitive swimming and returned for a second year the following summer. She started swimming during the winter three times a week under the direction of a swimming coach. However, Subject #2 had many other activities and this lasted only two months. Her other activities included ballet, piano, violin, ice skating, and Scouts.

Subject #2 was very understanding and cooperative toward and during the study. To the investigator, she seemed like a very happy, enthusiastic child.

A look at Table II of measurements for this subject shows figures at four competitive levels. These were practice, a competitive race in a league meet, a race during time trials for the Community Swim Association City Meet, and a competitive race in the city meet.

The systolic blood pressure for Subject #2 decreased after each situation; that is, after practice, after a race during a league meet, after a race during time trials for city meet, and after a race during the city meet. This decrease was a contrast

TABLE II

MEASUREMENTS FOR SUBJECT #2

Measurements	Practice	Competitive Meet: Before competition	Competitive Meet: Race	Time trials before city meet	City Meet: First day
Blood Pressure					
Systolic - before	108 104, 100 102	108 108 104,	102 102	124 118	110 112 114
Systolic - after	104 100, 100 100	- - -	98 96	118 116	117 100 102
Diastolic- before	70 60, 60 60	58 58 58,	60 60	70 70	50 60 60
Diastolic- after	68 68, 66 64	- - -	58 50	68 70	80 70 70
Pulse Rate					
Before	88 88, 96 96	92	92 96	120 124	112 124
After	132 116, 108 112	-	132 132	128 128	132 120
Respiration					
Before	24 24	32 24 24	32	28	32 28
After	24 28, 32		44	36	40 40
Grip					
Right - before	29 28 25, 30 25 25	34 29 29	25 25 28	31 31 36	39 34 32
- after	31 25 27, 30 30 31		36 37 34	34 30 31	31 32 29

to the other subjects who showed an increase from before to after various situations. The systolic measurements taken before practice sessions and before a league meet were about the same; but there was an increase on the measurements for the time trials of the city meet. Then, the scores indicated a decrease from time trials race to city meet race. Yet, the systolic scores before the city meet race were higher than scores before practice and a league meet race. The systolic measurements taken after the four different occasions were up and down. Those taken after a league race were lower than scores after practice sessions. The measurements were higher after the race at the time trials than the previous two situations, but were lower after the city meet race. However, the scores after the city meet race were higher than scores after either practice or league race.

The diastolic blood pressure increased after practice sessions and a race at the city meet. But, the diastolic decreased slightly after league meet race and time trials race. Looking across at the diastolic measurements taken before each competitive situation, they were about the same before practice and league race, were higher before time trials, and dropped at city meet to the same as they were before practice and a league race. The diastolic measurements taken after a league race were lower than those after practice but were higher than those after time trials and city meet.

The pulse rate increased after practice, league meet race, time trials, and city meet race as was to be expected. The measurements before practice and the league meet race were about the same

but started at a point higher at the time trials and city meet race which were about the same. The pulse rate measurements after a league race increased over practice but dropped after time trials although the drop was not as low as figures after practice. It decreased again slightly after city meet race.

The respiration rate was higher after each situation which was also expected. There was a slight rise with each occasion but figures for a league race, time trials, and city meet race were fairly much the same. The respiration rate after a league race rose greatly over practice. It dropped after time trials and rose again after city meet race but not as high as after league race.

Again, in the grip strength measurements, Subject #2 seemed to be opposite of the other cases. The grip strength increased definitely after the first two situations, was about the same before and after time trials, and showed a decrease only after the race during the city meet. The measurements were about the same before practice and before league race. They started higher before the time trials and increased before the city meet race. Grip strength measurements taken after a race during a league meet were highest of the four situations. The scores after practice, after time trials, and after city meet were almost identical.

Subject #2 showed no apparent harmful effects physiologically due to her activity in competitive swimming. However, this subject's measurements produce two interesting results. First, her systolic blood pressure decreased instead of increasing after a

competitive situation. Second, her grip strength showed an increase instead of a decrease.

Case #3

Subject #3 was eight-years-old and about to enter the third grade. Her father taught her to swim around the age of four. The summer of 1969 was the swimmer's second year on the team. However, Subject #3 was not a particularly good competitive swimmer and nearly always lost unless she was on a winning relay team. The breaststroke was her event in meets. During the second summer of swimming, the subject's younger brother was a strong competitor on the boys' team and accumulated an impressive record of wins.

Subject #3 learned about the swimming team from a friend and decided to join also. Besides swimming, the subject participated in Brownie Scouts, took piano lessons, and sometimes sang in the church choir. When asked if she became nervous or upset before competing she replied that she did not.

The observations of the investigator were that the child was hyperactive, nearly always moving and talking and wanted attention. She always wanted her measurements taken and usually wanted to be first. As for her swimming, Subject #3 was not especially good and did not work very hard in practice. She was often chided about being slow and about her poor habits of rhythmic breathing.

Table III for this subject has measurements for practice sessions only. She did not compete in the city meet and she competed infrequently in league meets because there were others in her age group who were better. Therefore, it was not possible to

TABLE III

MEASUREMENTS FOR SUBJECT #3

Measurement	Practice										
Blood Pressure											
Systolic - before	104,	110	106,	110	110,	108	100				
Systolic - after	-	-	-	98	96,	104	104				
Diastolic - before	56,	60	62,	58	50,	66	70				
Diastolic - after	-	-	-	58	58,	48	48				
Pulse Rate											
Before	104,	100,	112,	92	92	92					
After	-	-	104,	112	112						
Respiration											
Before	20,	28	16,	24,	24						
After	-	-	-	24,	24						
Grip											
Right - before	-	30	24	29,	30	24	26,	25	25		
- after	-	-	-	-	25	28	25,	24	29	25	

get any other measurements. Interestingly, the systolic blood pressure of Subject #3 decreased after practice sessions. The diastolic blood pressure increased slightly after one practice session and decreased after another.

Pulse rate for this subject decreased after one practice and increased after another. Her respiration rate remained the same before and after two practice sessions. Grip strength decreased after one practice session and averaged out about the same after another.

Case #4

Subject #4 was eight-years-old and had just completed the third grade in 1969. She learned to swim around the age of four from a Red Cross instructor at Green Valley pool. In the summer of 1969, Subject #4 was swimming competitively for the second year and continued the summer of 1970. She competed in backstroke, butterfly, freestyle, and relay events. This swimmer was especially strong, placing in the top spots with many first places to her credit. She also had an older sister on the team. Their parents were present at the swimming meets.

Her other interests included piano and violin lessons, Girl Scouts, and ice skating. She began swimming lessons at the YMCA pool during the winter but did not attend much. When asked if she grew nervous or upset before racing, she admitted that she did sometimes.

The investigator observed a great enthusiasm by the subject for competitive swimming. She was very excited at meets. She seemed sometimes shy and other times bouncy and gay.

Table IV of Subject #4 includes measurements taken at practice, before a competitive league meet, before and after a league race, and before and after two races during the city swim meet. The subject's systolic blood pressure increased in all cases, before to after practice, competitive league race, and city swim race. In addition, there was a steady increase in systolic blood pressure figures before practice session to before a league meet and league race to before city meet race. This was also true of the systolic figures taken after each situation.

The diastolic blood pressure before and after practice sessions increased. It stayed about the same after a competitive race. However, the measurements of the diastolic before and after races in the city meet showed a definite decrease. The diastolic blood pressure measured before practice and before a league meet occasion was about the same but was higher before the city meet competition. The diastolic scores after a league meet were lower than after practice. They increased slightly after her first race in the city meet and decreased to the same figures as they were after practice.

Pulse rate before and after each of the three situations showed an increase except in one practice session where it dropped and one where it remained the same. Again the measurements before a league race and a city meet race were higher than the measurements before practices. The pulse rate scores had increased considerably after the city meet compared to after practice session.

Respiration rate for Subject #4 gained after each situation except the second day of the city meet when it stayed the same. As

TABLE IV

MEASUREMENTS FOR SUBJECT #4

Measurement	Practice	Competitive Meet		City Meet Competition	
		Before meet	Race	First day	Second day
Blood Pressure					
Systolic-before	86, 100 100, 94 90, 90 92	110 104 100	104	120 118	114 120
Systolic-after	-, 104 104, 100 100, 100 100	- - -	110 110	122 124	122 112 120
Diastolic-before	50, 40 40, 48 48, 50 50	46 48 60	50	90 70	60 60
Diastolic-after	-, 50 50, 58 58, 58 50	- - -	44 50	54 62	54 58 58
Pulse Rate					
Before	92, 96 96, 92 -, 96 88	88 96 80	104 136	96 100	104 104
After	-, 88 -, 92 92, 108 104	- - -	108	124 112	128 124
Respiration					
Before	16, 12 8 12, 20, 20	16 16 16	12 12 16	24	28 28
After	-, 20 16 -, 24, 20	- - -	20 20	28 32	28
Grip					
Left - before	-, 20 17, 22 22, 21 16	26 22 27	34	25 16 29	22 17 25
Right -	25 30 27 28			25 22 29	
Left - after	-, 18 16, 25 22, 25 19	- - -	29	24 16 16	24 26 27
Right-	18 31, 34 30				

NOTE: The before meet and race occurred on the same night.

in the other two areas, there was an increase in measurements before and measurements after each of the three situations.

The grip strength for this subject was taken on the left hand because that was the preferred hand. (However, a few scores taken with the right hand were higher.) Based on the lefthanded measures during three different practice sessions, grip strength decreased after one session, stayed about the same one session, and showed a definite increase the third session. The grip strength showed a decline after a competitive race of a league meet. During the first day of the city meet, grip strength declined after the race. But on the second day's race, it increased. The measurements taken before each situation showed an increase from practice to league race. Then they declined during the first and second days of the city meet which were still higher than those before practice. Grip strength figures after practice were lower than figures after league race. Strength scores after first day's race of city meet dropped below practice score and then increased again but were below league race figures.

It appears, even within the limited number of measures, that the physiological functions of Subject #4 were highest during the competition of the Community Swim Association City Meet. As the level of competition increased so did the subject's physiological measurements.

Case #5

Subject #5 was nine and going into the fourth grade after the 1969 summer vacation. She began swimming after lessons at

four years of age and was competing for the second year. A follow-up inquiry found her swimming again during the summer of 1970. Subject #5 swam in backstroke, butterfly, and freestyle events. The child was a fairly good swimmer placing mostly second and third.

An older sister, who was also strong, swam on the team. The parents were present at the swimming meets. The subject decided to join because her friend was on the team and told her about it.

The child was extremely happy and enthusiastic about competitive swimming and being on the team. Her other activities were few. She liked to ice skate, swim in water ballet during the last part of summer, and to play a little tennis. During the year preceding 1969 summer, Subject #5 had been swimming once a week under a coach in the YMCA pool. However, she did not swim year-round following the summer of 1969. When asked if she was nervous or upset before swimming in competition, she answered that she was not. The investigator's impression of Subject #5 was that she was a very happy, apparently well-adjusted child and a pleasure to work with during the study.

Table V includes measurements for all four competitive type situations for Subject #5. This is the second subject to have measurements taken at the city meet time trials.

The systolic blood pressure before and after the four different levels of competition was up and down. On two occasions, there was a decrease in the measurements taken after practices. Once it increased. Measurements before and after league meet races showed an increase. At the second day of time trials for

TABLE V

MEASUREMENTS FOR SUBJECT #5

Measurement	Practice	Competitive Meet: Before meet	Competitive Meet: Race #1	Competitive Meet: Race #2	Time trials before City Meet: First day	Time trials before City Meet: Second day	City Meet: First day	City Meet: Second day
Blood Pressure								
Systolic-before	104 106, 100 100, 92 92* 92, 100 100	104 106, 102 102*	102 102*	100 106*	110	98 100	106	120
					106	110	98	120
							110	120
Systolic-after	100 98 100, 94 90, - - - 112 100	- -	116 114*	106 106*	-	94 110	106	126
			110			110	110	120
							104	120
Diastolic-before	78 70, 60 60, 60 50* 56, 60 60	60 50, 50 52*	60 64*	58 70*	68	68 72	68	70
			58	68	60	72	80	70
							70	70
Diastolic-after	56 70 68, 60 60, - - - 70 60	- -	68 54*	54* 58	-	60 68	58	74
			50			70	70	70
							70	70
Pulse Rate								
Before	80 72 72 72, 96 88*, 76 68	96 88, 96, 88 88	100 100*	120 112*	100	92 76	104	80
							104	84
After	100 108 104, 92 88, - - 116	- -	132 128*	120 124*	-	116 124	112	128
							104	124

TABLE V (continued)

Measurement	Practice	Competitive Meet: Before meet	Competitive Meet: Race #1	Competitive Meet: Race #2	Time trials before City Meet: First day	Time trials before City Meet: Second day	City Meet: First day	City Meet: Second day
Respiration								
Before	16 16 12, 16, 20*, 20	16 20 28, 24*	20*	28*	16	20	24	20 34
After	32 24 28, 20, - 24	- - -	28 36*	20*	-	32	36 32	28
Grip Strength								
(Left) Before	29 22 18, 17 18* 18, 29 31 29	36 30, 22 25* 28	30 32* 35	29 16* 27	34 32 31			30 30 35
	(30, 25) R (31, 34, 24)R	(45 30)R				(30 34 37)R	(35 35 31)R	
(Left) After	20, 18 16, - - -, 29 28	- - -	29 34* 29	30 29* 36	- -			35 28 36
	(21 29)R (35, 34)R					(34 29 29)R	(34 32 29)R	

*All scores with stars above were taken on same day - morning and night.

the city meet, the systolic blood pressure was up (when scores were averaged). The measurements at the city meet increased slightly. All the systolic scores taken before practice, competitive meet, time trials and city meet competition plus all the scores taken afterwards showed an increase on each occasion, with the highest occurring the second day of the city competition.

The diastolic blood pressure was sometimes up, sometimes the same, and most of the time down. After one practice session, diastolic pressure had dropped, on one occasion it remained the same, and on one occasion it rose slightly. The diastolic pressure dropped after both races in a league meet. It dropped also after a race during time trials for the city meet. At the city meet races, the subject's diastolic measurements were about the same before and after. When averaged together, the measurements showed a slight decrease one day and a slight increase the second day. The diastolic figures both before and after exercise increased steadily from practice sessions to city meet except during a league meet racing situation where it dropped.

Pulse rate for Subject #5 increased in each of the four situations as was expected. The measurements taken before each competitive situation were higher at the start of each new level of competition in most cases. However, there were two exceptions; figures were lower before the time trials and before the second day of the city meet. The figures recorded after each situation increased except after the time trials and the first day of city meet when they dropped somewhat from the continuous increase.

Respiration rate showed an increase after practice, league meet racing, time trials, and city meet racing, except for one time. The before scores started a little higher with each competitive level. The after scores also showed a slight increase.

Grip strength for Subject #5 decreased at practice and at the first league race. It increased after the second race at league meet and city meet race. Grip strength was greatest before the race on the second day of the city meet. It was second highest before the league meet race and lowest before a practice session. The same was true of the scores taken afterwards.

In comparing measurements of two races swum in the same night, the measurements in the second race were usually lower than those for the first race with a few exceptions. This was the opposite result, to the same situation, from Subject #1.

In summary, the measurements of each physiological function and performance level were highest at city meet competition and lowest at practice but were up and down in between. There were no apparent ill-effects to the physical well-being of this subject.

Case #6

Subject #6 was ten-years-old and had finished the fifth grade. She learned to swim when she was five at a day camp and continued lessons at Green Valley pool. The summer of 1969 was her first year of competitive swimming and she returned to it in the summer of 1970. This subject's event at meets was the breaststroke. However, she did not swim much the second year. Due to

age, she had moved up into the next age group and the older girls were better. The subject learned about the team from a friend and her mother was instrumental in her joining. Her parents did attend the meets. Other activities of Subject #6 included piano, dancing, and Girl Scouts. When asked if she became nervous or upset before swimming, the subject replied negatively. The investigator's observation was that this subject could be categorized as part of the large middle group. She was an average swimmer, neither the most exciting nor the poorest. She was congenial but did not stand out from the other team members.

Table VI of Subject #6 shows limited figures. The subject had measurements for practice sessions, before league meet competition, and before and after a league meet race. The systolic blood pressure in this case increased after a practice session but decreased after a league race. An increase in systolic blood pressure was experienced from measurements before practice sessions and before a league race. But, there was a slight decrease right before a league meet which accelerated before the race. The systolic scores after practice and after league race were about the same. The diastolic scores before the two swimming periods showed somewhat of an increase as did the scores taken after each period.

The pulse rate of the subject was up after practice and league racing. There was a rise of the starting pulse rate from practice to league meet to racing competition. There was an increase in measurements after the league race over measurements after practice.

TABLE VI

MEASUREMENTS FOR SUBJECT #6

Measurement	Practice	Competitive Meet: Before meet	Competitive Meet: Race
Blood Pressure			
Systolic-before	98 96, 110 110*, 112 114 112	110 *110	130 *132
Systolic-after	- - - - 122 110	- -	112 110* 110
Diastolic-before	58 58, 60 56*, 40 50 48	60 *50	60 *60
Diastolic-after	- - - - 50 50	- -	60 56* 64
Pulse Rate			
Before	76 104 76, 72 84*, 92 100	88 *92	100 *112
After	- - - - - 108	- -	120 *116
Respiration			
Before	28 28 24, 28*, 20	20*	20*
After	- - - - 28	-	32*
Grip			
Right-before	32 25 25, 31 29* 24, 18 20 12	31 29* 22	29 25* 25
after	- - - - - - 9 20 17	- - -	25 24 28

NOTE: All scores with stars above were taken on same day - morning and night.

Respiration rate increased after practice and after racing. Figures recorded before several practice sessions were higher than before the league meet or even the league race. The after score was higher after racing than after practice.

Grip strength decreased after practice and after a league race. Strength measurements before a league meet and league racing were higher than practice in one instance. Interestingly enough, measurements taken before practice sessions and before a competitive league meet on the same day were almost identical. These measures were slightly higher than measurements taken before other practice sessions. The measurements after the league race were higher than after practice.

All in all, the measurements taken at a league race were higher than those taken at practice session. One must be cautious of making any conclusions with only two competitive levels to compare. However, it does follow the pattern of the other subjects.

Case #7

Subject #7 was almost eleven-years-old and entering the sixth grade. She learned to swim at age three and had been swimming enough to include a junior life saving course. Although it was her first time at competitive swimming, she was very strong and was a consistent winner, usually first place. Her specialties were freestyle and some butterfly.

She found out about the team through friends, joined, and had thoroughly enjoyed it. Her father swam on a team in college. The parents attended the meets. The only other interest mentioned

by the subject was ice skating. When asked about being nervous or upset before competing, she admitted she did get nervous before swimming especially if the team were losing the meet.

Subject #7 became ill with a cold and flu July 17 and never recovered enough to finish the season with the team. This included missing the city meet. Up until this time, she was having a tremendous record of wins. The investigator's impression of the child was that she was very confident about herself as a winner and that she enjoyed the attention that came with winning.

Table VII shows measurements for several practice sessions and a competitive league race for Subject #7. The scores taken before and after practice and league competition showed an increase in systolic blood pressure. There was also an increase in scores before practice sessions to scores before a league meet to before a league race. There was also an increase in systolic blood pressure from after practice to after a league race.

The diastolic blood pressure increased after one practice session and decreased after another. It also decreased after the league race. The diastolic measurements taken before practice sessions and before a league meet were around the same but increased before a league race. The diastolic score after one practice was higher than at another but increased after a league race.

The pulse rate of Subject #7 increased after practice and after league racing. It also started higher before the race than before the meet and practice. The measurements after a league race were higher than after practice.

TABLE VII

MEASUREMENTS FOR SUBJECT #7

Measurement	Practice	Competitive Meet: Before meet	Competitive Meet: Race
Blood Pressure			
Systolic-before	110 108* 110, 110 110, 104 108 108	124 114* 114	120*
Systolic-after	- - - 114 114, 110 114	- - -	132
Diastolic-before	56 60* 50, 50 48, 60 60 50	60 50* 48,	70*
Diastolic-after	- - - 60 54, 50 50	- - -	66
Pulse Rate			
Before	100 80*, 108, 96 88	112 100* 84	120*
After	- - 136, 128	- - -	140
Respiration			
Before	16 20* 16, 20, 16	24 16* 20	24*
After	- - - 28, 32	- - -	48
Grip			
Right-before	36 35*, 38 36 41, 38 40 41	40 40* 47	40*
-after	- - 36 40 39, 35 41 35	- - -	31

NOTE: All scores with stars above were taken on same day - morning and night.

Respiration rate was up after practice and after racing. Rates taken before the two occasions were about the same with a slight increase indicated. Respiration taken after the competitive league race was higher than after a practice session.

Grip strength for this subject dropped after practice and after a league race. The scores before each situation were about the same with a slight increase indicated. The grip strength after the league race was lower than after practice.

Again, with this subject as with the others, there was a definite increase in physiological functions from a practice situation to competitive racing in a league meet. Also, there was no apparent harm done to her physiological functions.

Summary

The following pages summarize the individual cases to see if any patterns developed with the group as a whole. This summary includes only six cases since one of the seven had measurements from practice sessions only. Of the six cases, two had measurements from four competitive situations, two had measurements from three competitive situations, and two had them from two situations. Table VIII shows which cases increased or decreased when scores taken after a situation were compared with those taken before. Table IX shows the increase from practice to city meet of those measurements taken before each level. Table X shows the increase from practice to city meet of measurements taken after each level.

TABLE VIII

LIST OF CASES WHICH INCREASED OR DECREASED AFTER EACH COMPETITIVE SITUATION

Measurement	Practice Case #	Competitive Meet Case #	Time trials before City Meet Case #	City Meet Case #
Blood Pressure Systolic - Increased- before to after	1 4 5 6 7	1 4 5 7	5	1 4 5
Decreased- before to after	2 5	2 6	2	2
Blood Pressure Diastolic - Increased- before to after	1 2 4 5 6 7	6		2 5
Decreased- before to after	5 7	1 2 4 5 7	2 5	1 4 5
Same as	5			
Pulse Rate Increased- before to after	1 2 4 5 6 7	1* 2 4 5 6 7	2 5	1 2 4 5
Decreased- before to after	4	1**		
Same as	4			
Respiration Rate Increased- before to after	1 2 4 5 6 7	1** 2 4 5* 6 7	2 5	2 4 5
Decreased before to after		5**		1

TABLE VIII (continued)

Measurement	Practice Case #	Competitive Meet Case #	Time trials before City Meet Case #	City Meet Case #
Respiration Rate				
Same as		1*		
Grip Strength				
Increased-before to after	2 4	1* 2 5**		4****5
Decreased-before to after	1 4 5 6 7	1** 4 5* 6 7	5 (r)	1 2 4***
Same as	4		2	

*First race
**Second race
***First day
****Second day

TABLE IX

MEASUREMENTS TAKEN BEFORE EACH LEVEL OF COMPETITION TO SHOW INCREASE OF FUNCTIONS FROM PRACTICE TO CITY MEET

Function	Subject	Practice	Competitive Meet: First race	Competitive Meet: Second race	Time trials for City Meet	City Meet: First day	City Meet: Second day
Systolic blood pressure	1	84, 88	100 100	110 100 100		104 108 104	
	2	108 104, 100 102	102 102		124 118	110 112 114	
	3	110 110, 108 110					
	4	100 100, 94 90, 90 92	104			120 118	114 120
	5	104 106, 100 100, 100 100	102 102 102	100 106 110	98 100 110	106 98 110	120 120 120
	6	112 114 112	130 132				
	7	110 110, 104 108 108	132				
Diastolic blood pressure	1	40 50	56 54	70 70 70		58 60 56	
	2	70 60, 60 60	60 60		70 70	50 60 60	
	3	58 50, 66 70					
	4	40 40, 48 48, 50 50	50			90 70	60 60
	5	78 70, 60 60, 60 60	60 64 58	58 70 68	68 72 72	68 80 70	70 70 70
	6	40 50 48	60 60				

TABLE IX (continued)

Function	Subject	Practice	Competitive Meet: First race	Competitive Meet: Second race	Time trials for City Meet	City Meet: First day	City Meet: Second day
	7	50 48 60 60 50	70				
Pulse Rate	1	96	100 104	104 120		108 116	
	2	88 88, 96 96	92 96		120 124	112 124	
	3	112, 92 92 92					
	4	96 96, 92, 96 88	104 136			96 100	104 104
	5	80 72 72 72 76 68	100 100	120 112	92 76	104 104	80 84
	6	92 100	100 112				
	7	108, 96 88	120				
Respiration rate	1	20	28	32		36 32	
	2	24, 24	32		28	32 28	
	3	24, 24					
	4	12 8 12, 20, 20	12 12 16			24	28 28
	5	16 16 12, 16, 20	20 28		20	24	20 34
	6	20	20				
	7	20, 16	24				

TABLE IX (continued)

Function	Subject	Practice	Competitive Meet: First race	Competitive Meet: Second race	Time trials for City Meet	City Meet: First day	City Meet: Second day
Grip Strength							
Right hand	1	18 20 16	18 25 17	24 19 12		20 20 20	
Right hand	2	29 28 25, 30 25 25	25 25 28		31 31 36	39 34 32	
Right hand	3	30 24 26, 25 25					
Left hand	4	20 17, 22 22, 21 16	34			25 16 29	22 17 25
Left hand	5	29, 22 18, 29 31 29	30 32 35	29 16 27			30 30 35
Right hand	6	18 20 12	29 25 25				
Right hand	7	38 36 41, 38 40 41	40				

TABLE X

MEASUREMENTS TAKEN AFTER EACH LEVEL OF COMPETITION TO SHOW INCREASE OF FUNCTIONS FROM PRACTICE TO CITY MEET

Function	Subject	Practice	Competitive Meet: First race	Competitive Meet: Second race	Time trials for City Meet	City Meet: First day	City Meet: Second day
Systolic blood pressure	1	94 94	100 100	102 102		110 110	
	2	104 100, 100 100	98 96		118 116	117 100 102	
	3	98 96, 104 104					
	4	104 104, 100 100, 100 100	110 110			122 124	122 112 120
	5	100 98 100, 94 90, 112 100	116 114 110	106 106	94 110 110	106 110 104	126 120 120
	6	122 110	112 110 110				
	7	114 114 110 114	132				
Diastolic blood pressure	1	58 56	50 50	54 54		60 50	
	2	68 68, 66 64	58 50		68 70	80 70 70	
	3	58 58, 48 48					
	4	50 50, 58 58, 58 50	44 50			54 62	54 58 58
	5	56 70 68, 60 60, 70 60	68 54 50	54 58	60 68 70	58 70 70	74 70 70
	6	50 50	60 56 64				
	7	60 54, 50 50	66				

TABLE X (continued)

Function	Subject	Practice	Competitive Meet		Time trials for City Meet	City Meet	
			First race	Second race		First day	Second day
Pulse Rate	1	112	120	104 120		108 116	
	2	132 116, 108 112	132 132		128 128	132 120	
	3	104,112 112					
	4	88, 92 92,108 104	108			124 112	128 124
	5	100 108 104, 92 88,116	132 128	120 124	116 124	112 104	128 124
	6	108	120 116				
	7	136,128	140				
Respiration rate	1	24	28	40		28	
	2	24 28, 32	44		36	40 40	
	3	24, 24					
	4	20 16, 24, 20	20 20			28 32	28
	5	32 24 28, 20, 24	28 36	20	32	36 32	28
	6	28	32				
	7	28, 32	48				

TABLE X (continued)

Function	Subject	Practice	Competitive Meet: First race	Competitive Meet: Second race	Time trials for City Meet	City Meet: First day	City Meet: Second day
Grip Strength							
Right hand	1	19 16 16	20 20 19	17 17 17		18 13 5	
Right hand	2	31 25 27, 30 30 31	36 37 34		34 30 31	31 32 29	
Right hand	3	30 24 26, 25 25					
Left hand	4	18 16, 25 22, 25 19	29			24 16 16	24 26 27
Left hand	5	20, 18 16, 29 28	29 34 29	30 29 36			35 28 36
Right hand	6	9 20 17	25 24 28				
Right hand	7	36 40 39, 35 41 35	31				

Systolic Blood Pressure

In most of the cases, the systolic blood pressure was higher after each competitive situation than before it as shown in Table VIII, page 76. The systolic pressure increased in four of six cases after practice sessions, four of six cases after a league race, one of two cases after time trials for the city meet, and three of four cases after the city meet. It was interesting to note that the measurements for one subject decreased after each level of competition.

A steady increase of measurements taken before each level of competition was observed in Table IX, page 78. Of the four cases which had scores for practice, a league race and a city meet race (two of which also had time trial scores), all had scores before each situation that started a little higher than the one before. The remaining two cases which had scores for practice and league racing only also showed an increase of the second situation over the first. The systolic blood pressure measurements taken after each of the four situations also showed an increase which can be seen in Table X, page 81. Three of the four cases showed a steady increase. The fourth case was up and down with highest scores at time trials. However, scores after a city meet race were higher than scores after practice. One case with scores for only two situations showed an increase while another one stayed the same.

Diastolic Blood Pressure

The diastolic blood pressure decreased after each competitive situation except practice. After practice sessions, six out

of six had increased in their diastolic rate which is shown in Table VIII, page 76. However, two of these also showed a decrease after a second practice situation. After league meet racing, five out of six cases decreased. Both subjects with time trial figures decreased in diastolic blood pressure after them. At the city meet, two out of four subjects decreased.

Comparing the diastolic blood pressure before each competition level showed three of six cases were higher before city meet race than before practice. Table IX, page 78, illustrates this. Two cases with measures for two situations also showed an increase from practice to league racing. One case remained the same throughout except for a rise before time trial racing. However, the increase of scores before city meet racing over practice was not steady because scores in between were up and down.

The diastolic blood pressure taken after each competitive situation increased in four out of six cases as shown in Table X, page 81. Two of those four had only two situations to compare. One of the four did show a decrease after a league race but went right back up for time trials and city meet races. One of the remaining two decreased from practice to league racing, had no scores for time trials, and then showed an increase at a city meet race over practice. Another case decreased from practice to the league race and showed only a very slight increase in two city meet races.

Pulse Rate

The pulse rate measurements showed an increase after practice, league races, time trial races, and city meet races.

All six cases increased after practice which is shown in Table VIII, page 76. One case with three different sets of scores for practice increased once, decreased once, and remained the same a third time. Six out of six rose after a league race. However, one of the six showed an increase in pulse rate after the second race on the same night. The two cases with time trial measurements both increased. Finally, four out of four cases increased their pulse rate after city meet races.

In comparing the measurements before each level of competition, all six cases increased in pulse rate over practice which can be seen in Table IX, page 78. Two of these had only two situations for comparisons. One of the six remained the same from practice to a league race but was up at time trials before a city meet race. One case had measurements that increased from practice to a league race and then decreased before a time trial race but not to the level of the measurements before practice.

The pulse rate measurements after each situation showed an increase with each situation in five of six cases as Table X, page 81, shows. Two of the five had scores for practice and league races only. One of the five showed an increase from practice to the first race of league meet, a decrease after the second race, and an increase again after city meet race. The sixth case increased from practice to a league race but declined after a time trial race. Measurements after the city meet race were the same as they were after practice.

Respiration Rate

Respiration rate measurements showed an increase between those taken before and after each competitive situation. All six subjects increased their rate after practice as Table VIII, page 76, shows. All of them showed an increase after a league meet race also. Two of the six swam two races in the same night. Of these two, one increased after the first race and decreased after the second. The other had measurements that remained the same before and after the first race and increased after the second. Both cases with time trial scores produced an increase. Three out of four cases had respiration rates that increased after city meet races. The fourth case decreased.

Four of six cases, all having measurements for three or more situations, showed a continuous increase of scores before each new competitive level. Table IX, page 78, shows these scores. Of the remaining two cases with only two situations for comparison, one had scores that stayed the same and one had scores that decreased.

In comparing measurements taken after each level of competition, six out of six cases showed increases over practice measurements. Table X, page 81, contains the measurements for these cases. Two of these cases increased from practice to the league race. Two displayed a steady increase from practice through the city meet races. One increased from practice to the first race of the league meet, increased greatly after the second race but then dropped after the city race. The last case had measurements

that increased from practice to the league race, decreased after the time trial race, and increased after the city meet race.

Grip Strength

Grip strength measurements compared before and after each competitive situation decreased as would be expected. Five of six cases showed a decrease after practice according to Table VIII, page 76. The sixth case increased. One of the six cases had three sets of practice scores. One time she increased, one time decreased, and one time stayed the same before and after activity. Five of the six subjects had scores that decreased after a competitive league race. The sixth case increased (same one as in practice). Two of the five who swam two races in one night decreased after one race and increased after another. Of the two cases with time trial measurements, one increased and the other remained the same. Three of four decreased after city meet race. One increased (not the same one as did in practice and league race).

Comparing all the grip strength measurements taken before each situation, four out of six cases increased over practice. Table IX, page 78, illustrates this. One case had two comparisons only. One case had figures that remained the same through the league race and then increased before time trial race and increased again before city meet race. Two cases remained the same.

A comparison of scores taken after each situation showed three cases with scores increasing over practice scores as

Table X, page 81, shows. Two cases had scores which were the same after practice and after city meet race but increased after a league meet race. The sixth case had measurements that decreased from after practice to after a league race.

CHAPTER VI

CONCLUSION

The purpose of this study was to determine the effects of competitive swimming on selected physiological measures and performance levels of seven to ten-year-old girls. The three selected physiological measures were blood pressure, pulse rate, and respiration rate. The one performance level was grip strength. Seven girls between the ages of seven and ten were used as subjects. Measurements of the four functions were taken at four levels of competition: at practice considered the lowest form, at league meet races, at time trial races for the Community Swim Association City Meet, and at the City Meet considered the highest form of competition. Of the seven subjects, two girls were measured in all four situations, two were measured for all but the time trials, two provided scores for two situations, and one was measured at practice only.

Within the limited amount of data collected, the following points seem justified:

1. For most subjects, physiological measurements taken after practice, after a league race, after a time trial race for the city meet, and after the city meet seemed to increase over measurements taken before each situation.

a. This was true of systolic blood pressure, pulse rate, and respiration rate.

b. The only function that seemed to deviate from what might be expected was the diastolic blood pressure.

2. The performance level measurement, grip strength, appeared to decrease after practice, league racing, time trial racing at the city meet, and at city meet racing.

3. Generally speaking, when comparing measurements taken before each of the four competitive situations, the measurements started each time at a point a little higher at each level of competition. Therefore, it resulted that the physiological and performance level measurements were highest before the city meet.

   a. This was true of systolic blood pressure, pulse rate, respiration rate, and grip strength.

   b. Diastolic blood pressure remained about the same before each different competitive situation.

4. When comparing measurements taken after each of the four competitive situations, the measurement at each level was a little higher than the previous level in the majority of subjects. Therefore, a steady increase was observed from practice to city meet races. This was true of all four functions.

It appeared the physiological and performance level functions increased as the competitive level increased. Also, there appeared to be no apparent ill-effects such as nausea or fainting to any of the physiological systems in any of the subjects as a result of participating in competitive swimming.

General statements concerning the effects of competitive swimming on physiological measures, however, should be viewed carefully because of the scattered data on isolated subjects and competitive situations in this study. Measurements taken in field type research proved to be difficult and might cause false impressions.

Future studies in this area are recommended because of the growing popularity of competitive swimming, the lack of available information, and lack of conclusive research for the elementary school aged child. Following are some recommendations for future studies in this area:

1. More stable or controlled research conditions under which measurements are taken are needed. Perhaps laboratory methods rather than field situations are necessary.
2. Many more cases are needed in order to make statistical conclusions.
3. Much more data on each subject are needed. Day to day and situation to situation measurements should be taken. This may necessitate more equipment and more

testing personnel. An alternative would be to use one subject and test him thoroughly.

4. The research design should be more limited. For example, all subjects tested should be doing the same stroke.
5. Better measuring methods are needed. For example, methods are needed that would enable researchers to take measurements immediately before and after swimming to secure more accurate data. One might investigate the possibility of gathering data by telemetry methods.
6. A questionnaire for swimmers and/or parents might be advisable. In addition, some method to measure psychological and emotional factors could be added.
7. It might be advisable for all subjects to have physical examinations before participating in competitive swimming studies.
8. An attempt for a more random selection of subjects might be advisable.

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APPENDIXES

APPENDIX A

Letter to Parents

Letter to Child

THE UNIVERSITY OF NORTH CAROLINA
AT GREENSBORO

Department of Health, Physical Education
and Recreation

June 28, 1969

Mr. and Mrs.

Greensboro, North Carolina

Dear Mr. and Mrs.

This summer I have begun working on my graduate thesis which is concerned with competitive swimming of elementary school age children. I will be taking blood pressure, pulse rate, and respiration rate before and after swimming during practice sessions and competitive meets.

Your daughter has volunteered to help me and I would like to ask your permission to include her in the study. Both Mr. Mike King, the pool manager, and Miss Ann Dewey, the girl's coach, know what I am doing and have approved my working with the girls.

I would appreciate very much your cooperation. Your daughter can be a real asset to this study. If you will consent, please sign below and have (child's name) return this letter to me at the next practice.

If you have questions, I may be reached at the University in Hawkins Hall by calling either 379-7478 or 379-5185.

Thank you.

Sincerely,

Diane Walker
Graduate Student

Rosemary McGee
Adviser

I give my permission for my daughter to be included in the study.

Signed _____

THE UNIVERSITY OF NORTH CAROLINA
AT GREENSBORO

Department of Health, Physical Education
and Recreation

2502 14th Avenue West
Bradenton, Florida
August 2, 1969

Miss

Greensboro, North Carolina

Dear ,

I want to express my sincere thank you for being in my study. You played an important part. It has been great fun for me to work with and to get to know you in the past four weeks. There were some girls who volunteered but because of limited time, I did not have the opportunity to take measures on them. To these I want to especially express my appreciation for volunteering and standing in readiness.

I also want to add congratulations to the Green Valley team on their second place victory in the City Meet. Keep working hard and make it first next year.

Fondly,

Diane Walker

APPENDIX B

Copy of Form Upon Which
Data Was Recorded

COPY OF FORM UPON WHICH
DATA WAS RECORDED

Subject's Name _____ Date _____

Time Measurement Taken				
Respiration (15 sec.)				
Pulse Rate (15 sec.)				
Blood Pressure mm. Hg.				
Grip Strength				
Rest				
Practice				
Competition				
Stroke Used				
Place Won				
Time				
Distance				
Official/ Unofficial				
# of Race				
Home/Away				
Opponent				
Won/Lost				
Parents Attended				
Size Crowd				
Water Temp.				
Weather				
Comments				

APPENDIX C

Questions Asked at Interview

QUESTIONS ASKED AT INTERVIEW

1. Birthdate
2. Grade in school for the past year.
3. Length of time child had been swimming.
4. Length of time child had been swimming competitively.
5. Did swimmer compete the summer following the study?
6. Does swimmer have any brother or sister swimming on the team?
7. Did parents ever swim competitively? When? Where?
8. Did child enjoy swimming competitively?
9. Did child swim year round? Was he coached in swimming?
10. Whose idea was it to join the team?
11. How did child learn to swim?
12. Did swimmer get upset or nervous before a meet or a specific race?
13. What activities did the swimmer participate in besides swimming? Ex. piano, Scouts, dance, extra-curricular at school, etc.
    What activities did who do year round, just in the summer, just in the winter?

APPENDIX D

Schedule and Participants

THE SCHEDULE AND PARTICIPANTS FOR THE GREEN VALLEY VS. ELKS CLUB LEAGUE MEET

1. Medley Relay - 8 and under-boys

2. GV	M. Cox	
	J. Galjon	
	J. Kirkman	
	R. Elkins	
3. E	Tim Carroll	
	Kevin Gray	
	Ken Graham	
	Mark McCuiston	

2. Medley Relay - 8 and under-girls

2. GV	E. Stamey	
	J. Geddings	
	M. Dees	
	J. Waldon	
3. E	Kathy Carpenter	
	Terry McCormick	
	Kelly Harnes	
	Stacey Engle	

3. Medley Relay - 9-10 boys

2. GV	B. Campbell	
	W. York	
	J. Bannister	
	H. Elkins	
3. E	Glen Eure	
	Kervin McGinty	
	Ken Clark	
	Robby Odom	

4. Medley Relay - 9-10 girls

2. GV	C. Shankle	
	D. Bohlken	
	R. Haley	
	M. Horan	
3. E	Suzanne Latham	
	Carolyn Haines	
	Nancy Cullingham	
	Carla LaFata	

5. Medley Relay - 11-12 boys

2. GV	J. Allen	
	H. Boran	
	S. Meyer	
	D. Elkins	
3. E	Charlie Murphy	
	Buddy Eure	
	Hal Barrier	
	Michiel Hamilton	

6. Medley Relay - 11-12 girls

2. GV	S. Albright	
	E. Dees	
	J. Horan	
	J. Smith	
3. E	Kathy Haines	
	Julie Jackson	
	Jodi Harty	
	Susan Cecil	

7. Medley Relay - 13-14 boys

2. GV	W. Wolbert	
	P. Aycock	
	R. Bohlken	
	R. Ashley	
3. E	Jerry Lorle	
	Ed Hamilton	
	Mark Hunneman	
	Bob Honeycutt	

8. Medley Relay - 13-14 girls

2. GV	A. Michaud	
	M. Jeanmoregin	
	W. Wolbert	
	K. Smith	
3. E	Kathy Leach	
	Debbie Leach	
	Lynn Crater	
	Pat Mahaffie	

9. Medley Relay - 15-17 boys

2. GV R. Bohlken
K. Bradner
S. Baron
J. Elkins

3. E Charlie Barrier
Micky Hunneman
Tom Bullock
Bob Vail

10. Medley Relay - 15-17 girls

2. GV D. Wilson
G. Gorrell
K. McKay
K. McLeod

3. E Lynn Manzi
Frances Ehrlick
Debbie Hogy
Debbie Osborne

11. Backstroke - 8 and under boys

2. GV J. Galjon
1. E Ken Graham
4. GV M. Cox
3. E Tim Carroll

12. Backstroke - 8 and under girls

2. GV D. Jeanmoujin
1. E Kathy Carpenter
4. GV E. Stamey
3. E Tracey Eure

13. Backstroke - 9-10 boys

2. GV B. Campbell
1. E Kevin McGinty
4. GV J. Bannister
3. E Glenn Eure

14. Backstroke - 9-10 girls

2. GV C. Shankle
1. E Suzanne Latham
4. GV M. Horan
3. E Nancy Cullingham

15. Backstroke - 11-12 boys

2. GV S. D. Elkins
1. E Charlie Murphy
4. GV S. Meyer
3. E Buddy Eure

16. Backstroke - 11-12 girls

2. GV S. Bounds
1. E Jodi Harty
4. GV S. Albright
3. E Kathy Haines

17. Backstroke - 13-14 boys

2. GV W. Wolbert
1. E Bob Honeycutt
4. GV R. Bohlken
3. E Jerry Poole

18. Backstroke - 13-14 girls

2. GV K. Smith
1. E Kathy Leach
4. GV A. Michaud
3. E Lynn Manzi

19. Backstroke - 15-17 boys

1. E Tom Bullock
2. GV
3. E Charlie Barrier
4. GV J. Elkins

20. Backstroke - 15-17 girls

1. E. Debbie Hogy
2. GV D. Wilson
3. E Debbie Osborne
4. GV K. McKay

21. Breaststroke - 8 and under boys

1. E Kevin Gray
2. GV J. Galjon
3. E Mark McCuiston
4. GV M. Cox

22. Breaststroke - 8-under girls

1. E. Terry McCormick
2. GV D. Jeanmoujin
3. E Kelly Haines
4. GV S. Geddings

23. Breaststroke - 9-10 boys

1. E Kevin McGinty
2. GV W. York
3. E Glenn Eure
4. GV H. Elkins

24. Breaststroke - 9-10 girls

1. E Carolyn Haines
2. GV M. Craven
3. E Teresa O'Connell
4. GV D. Bohlken

25. Breaststroke - 11-12 boys

1. E Buddy Eure
2. GV G. Cox
3. E Hal Barrier
4. GV H. Baron

26. Breaststroke - 11-12 girls

1. E Julie Jackson
2. GV S. Albright
3. E Kathy Haines
4. GV E. Dees

27. Breaststroke - 13-14 boys

1. E Ed Hamilton
2. GV R. Bohlken
3. E Mark Hunneman
4. GV P. Aycock

28. Breaststroke - 13-14 girls

1. E Lynn Crater
2. GV K. Smith
3. E Debbie Leach
4. GV M. Jeanmoujin

29. Breaststroke - 15-17 boys

1. E Bob Vail
2. GV K. Bradner
3. E Micky Hunneman
4. GV S. Baron .

30. Breaststroke - 15-17 girls

1. E Frances Ehrlick
2. GV K. McKay
3. E Linda Ehrlick
4. GV G. Gorrell

31. Butterfly - 8 and under boys

1. E Tim Carroll
2. GV J. Kirkman
3. E Ken Graham
4. GV D. Goff

32. Butterfly - 8 and under girls

1. E Terry McCormick
2. GV M. Dees
3. E Kelly Haines
4. GV E. Stamey

33. Butterfly - 9-10 boys

1. E Robby Odom
2. GV B. Campbell
3. E Ken Clarke
4. GV J. Bannister

34. Butterfly - 9-10 girls

1. E Nancy Cullingham
2. GV M. Horan
3. E Patti Gray
4. GV R. Haley

35. Butterfly - 11-12 boys

1. E Charlie Murphy
2. GV H. Baron
3. E Hal Barrier
4. GV S. Meyer

36. Butterfly - 11-12 girls

1. E Jodi Hartig
2. GV J. Horan
3. E Susan Cecil
4. GV S. Albright

37. Butterfly - 13-14 boys

1. E Mark Hunneman
2. GV B. Ashley
3. E David McKinney
4. GV R. Bohlken

38. Butterfly - 13-14 girls

1. E Lynn Crater
2. GV A. Michaud
3. E Diane Phillips
4. GV W. Wolbert

39. Butterfly - 15-17 boys

1. E Tom Bullock
2. GV
3. E Micky Hunneman
4. GV S. Barm

40. Butterfly - 15-17 girls

1. E Debbie Hogy
2. GV D. Wilson
3. E Frances Ehrlich
4. GV K. McKay

41. Freestyle - 8 and under boys

1. E Tim Carroll
2. GV J. Galjon
3. E Ken Graham
4. GV M. Cox

42. Freestyle - 8 and under girls

1. E Terry McCormick
2. GV M. Dees
3. E Kelly Haines
4. GV E. Stamey

43. Freestyle - 9-10 boys

1. E K. Clark
2. GVP H. Elkins
3. E G. Eure
4. GVP J. Bannister

44. Freestyle - 9-10 girls

1. E C. LaFata
2. GVP M. Horan
3. E N. Cullingham
4. GVP R. Haley

45. Freestyle - 11-12 boys

1. E B. Eure
2. GVP H. Baron
3. E H. Barrier
4. GVP S. Meyer

46. Freestyle - 11-12 girls

1. E C. Kutos
2. GVP E. Dees
3. E Susan Cecil
4. GVP J. Horan

47. Freestyle - 13-14 boys

1. E M. Hunneman
2. GVP B. Ashley
3. E B. Honeycutt
4. GVP W. Wolbert

48. Freestyle - 13-14 girls

1. E Lynn Crater
2. GVP A. Michaud
3. E K. Leach
4. GVP W. Wolbert

49. Freestyle - 15-17 boys

1. E. G. O'Steen
2. GVP J. Elkins
3. E Bob Vail
4. GVP S. Baron

50. Freestyle - 15-17 girls

1. E. D. Osborne
2. GVP K. McLeod
3. E. D. Osborne
4. GVP K. McKay

51. Freestyle Relay - 8 & under boys

2. GVP M. Cox
J. Galgon
R. Elkins
D. Goff

3. E. T. Carroll
M. McCuiston
K. Gray
K. Graham

52. Freestyle Relay - 8 & under girls

2. GVP M. Atkinson
J. Waldon
M. Dees
E. Stamey

3. E. K. Carpenter
K. Haines
T. McCormick
S. Engle

53. Freestyle Relay - 9-10 boys

2. GVP B. Campbell
W. York
J. Bannister
H. Elkins

3. E. K. McGinty
R. Odom
G. Eure
K. Clark

54. Freestyle Relay - 9-10 girls

2. GVP J. Michaud
C. Shankle
R. Haley
M. Horan

54. (continued)

3. E N. Cullingham
C. LaFata
P. Gray
S. Current

55. Freestyle Relay - 11-12 boys

2. GVP J. Allen
H. Baron
S. Meyer
D. Elkins

3. E B. Eure
C. Murphy
M. Hamilton
H. Barrier

56. Freestyle Relay - 11-12 girls

2. GVP E. Dees
S. Albright
J. Smith
J. Horan

3. E S. Cecil
C. Kutes
M. L. Guest
J. Hamilton

57. Freestyle Relay - 13-14 boys

2. GVP B. Pleasants
B. Ashley
P. Aycock
W. Wolbert

3. E M. Hunnemond
B. Honeycutt
Ed Hamilton
J. Poole

58. Freestyle Relay - 13-14 girls

2. GVP K. Smith
J. Jeanmougin
A. Michael
W. Wolbert

58. (continued)

3. E P. Mahaffee
K. Leach
L. Crater
K. Teeter

59. Freestyle Relay - 15-17 boys

2. GVP R. Bohlken
K. Bradner
S. Baron
B. Pleasants

3. E B. Vail
C. Barrier
M. Hunneman
G. O'Steen

60. Freestyle Relay - 15-17 girls

2. GVP D. Wilson
G. Gorrell
K. McLeod
K. McKay

3. E D. Osborne
D. Hagy
F. Ehrlich
L. Manzi

APPENDIX E

Correction Table for Grip Dynamometer With Push-Pull Attachment

TABLE XI

CORRECTION TABLE FOR GRIP DYNAMOMETER
WITH PUSH-PULL ATTACHMENT
(Reading and Corrections in Lbs.)

Reading	True Value	Reading	True Value
8	0	40	36
9	1	41	37
10	2	42	38
11	3	43	39
12	4	44	40
13	5	45	41
14	7	46	42
15	8	47	44
16	9	48	45
17	10	49	46
18	11	50	47
19	12	51	48
20	13	52	49
21	14	53	51
22	16	54	52
23	17	55	53
24	18	56	54
25	19	57	55
26	20	58	56
27	21	59	57
28	22	60	58
29	24	61	59
30	25	62	60
31	26	63	61
32	27	64	63
33	28	65	64
34	29	66	65
35	30	67	66
36	31	68	67
37	32	69	69
38	34	70	70
39	35	71	71
		72	72
		73	73
		74	74
		75	75